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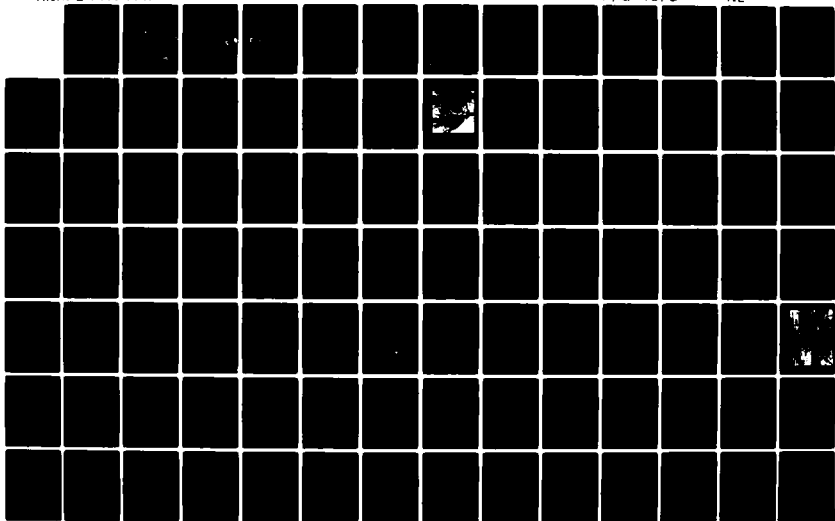
FLOOD CONTROL STATE ROAD AND EBNÉR COULEES LA CROSSE  
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ST PAUL DISTRICT APR 82

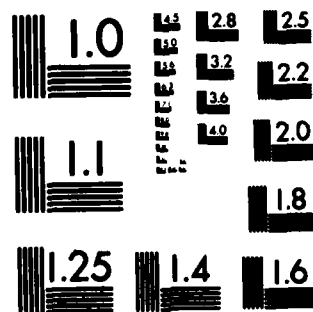
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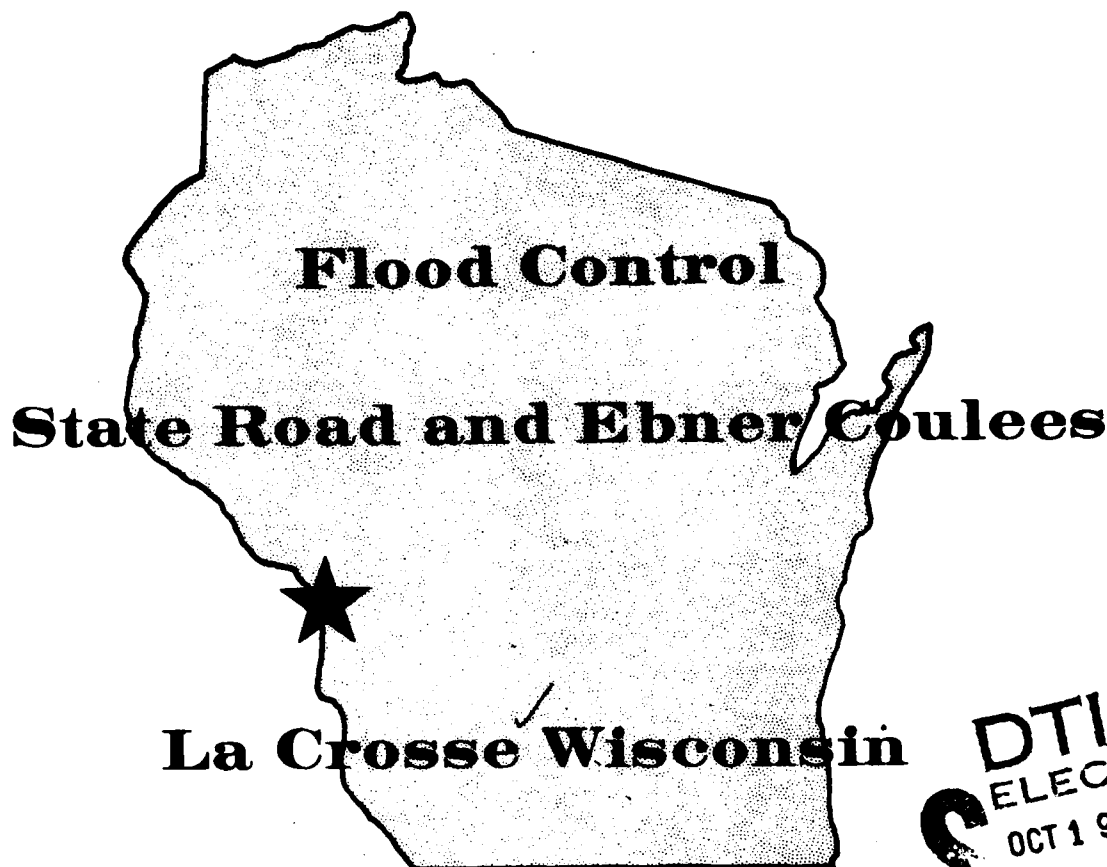


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## General Design Memorandum

### Phase I

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## Plan Formulation and Hydrology and Draft Environmental Impact Statement

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St. Paul District ✓

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A120480	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) FLOOD CONTROL, STATE ROAD AND EBNER COULEES, LA CROSSE, WISCONSIN, General Design Memorandum Phase I, Plan Formulation and Hydrology and Draft Environmental Impact Statement		5. TYPE OF REPORT & PERIOD COVERED Draft - EIS
7. AUTHOR(s)		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Paul 1135 U.S. Post Office and Custom House St. Paul, MN 55101		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
		12. REPORT DATE April 1982
		13. NUMBER OF PAGES 365
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Flood control Environmental Impact Statements State Road Coulee Ebner Coulee La Crosse, Wisconsin		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report and EIS reevaluate and update studies contained in a survey report, dated 3 November 1967, and a draft phase I general design memorandum (GDM) dated November 1976. For State Road Coulee recommended channel modifications include rectangular and trapezoidal concrete, channels from Hagen Road bridge to just downstream of the Burlington Northern railroad bridge, and a concrete and riprap channel with outlet control between the railroad bridge and the Mississippi River marsh area. For Ebner Coulee, the best plan would consist of concrete channel modifications and underground concrete pipe diversion of flows		

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northward to Miller Coulee and thence to the La Crosse River. However, the second plan is no longer economically feasible and only the first is recommended for construction.

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## SYLLABUS

This report and environmental impact statement (EIS) reevaluate and update previous studies for State Road and Ebner Coulees, Wisconsin, contained in a survey report, dated 3 November 1967, and in a draft phase I general design memorandum (GDM) dated November 1976. The current study uses the Water Resources Council's Principles and Standards as the basic planning guidelines. The survey report's recommendations for channel modifications on both coulees and additional diversion works for Ebner Coulee were authorized by Congress in the 1968 Flood Control Act (Public Law 90-483).

A relatively large lapse in time since completion of the 1967 survey report required reaffirmation or reformulation of the authorized project in the 1976 draft phase I GDM. Reformulation was required because of changes in the area's physical development, construction costs, national policy, and public opinion. The current phase I report, which updates the 1976 draft, includes an environmental impact statement as part of the main report.

A major water resource problem in the coulees is the progressively increasing flood damage potential from continuing residential development in the downstream floodplains. In October 1980, about 1,808 residential units were located in the standard project floodplain, compared with an estimated 1,100 units in 1975, 725 units in 1970, and less than 100 structures in 1951. Single-family residential units within the 100-year and standard project floodplains now total 767 and 1,095, respectively. Future residential development is expected to be more restricted as floodplain regulations are strictly enforced.

In accordance with the authorized purpose of flood control, this study concentrates on meeting the flood damage reduction needs and examines other water and related land resource needs with regard to incorporating such needs incidental to the best overall flood control plan.

This study has established that flood damages for State Road Coulee can be reduced by a solution that meets the requirements for Federal participation. However, an economically feasible solution could not be developed for the separable Ebner Coulee portion of the project. The most beneficial of the 12 alternatives evaluated for State Road Coulee is a modification of the lower portion of State Road Coulee consisting of 2.3 miles of concrete channels and 0.2 mile of concrete and riprap channels near the mouth. The plan includes related bridge replacements and public and private utility relocations. The total estimated cost is \$19,850,900, with Federal costs estimated at \$18,546,700 and non-Federal costs at \$1,304,200.

The La Crosse County Board of Supervisors, the La Crosse City Council, and the town of Shelby passed separate resolutions in 1978, requesting the Corps of Engineers to continue work on State Road and Ebner Coulees. The 17 September 1978 County Board Resolution further stated that La Crosse County will support and cooperate with all areas of government and will serve as the sponsoring unit.

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FLOOD CONTROL  
STATE ROAD AND EBNER COULEES, WISCONSIN

GENERAL DESIGN MEMORANDUM  
PHASE I  
PLAN FORMULATION AND HYDROLOGY

PROJECT AUTHORIZATION

The project for flood damage reduction recommended by the Chief of Engineers in House Document No. 360, 90th Congress, 2d session, provides for channel modifications along the lower reaches of State Road and Ebner Coulees, including diversion works leading from Ebner Coulee north to Miller Coulee and thence to the La Crosse River. The project was authorized by the Flood Control Act approved 13 August 1968 (Public Law 90-483).

The required local cooperation as set forth by the Board of Engineers for Rivers and Harbors in the project document is as follows:

- a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project.
- b. Hold and save the United States free from damages due to the construction works.
- c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.
- d. Make all necessary relocations and alterations of buildings, utilities, highway bridges, sewers, and related facilities, except as otherwise provided.
- e. Prevent any encroachments which would reduce the flood-carrying capacity of either the improved channel on State Road Coulee or the diversion works for Ebner Coulee.

f. Maintain the capacity of the existing Ebner Coulee channel immediately east of and parallel with the Burlington Northern railroad tracks and preserve the existing outlet of Ebner Coulee at the storm sewer at Farnam Street.

g. Provide guidance and leadership in preventing unwise future development of the floodplain by use of appropriate floodplain management techniques to reduce flood losses.

h. In the event of future development or improvements within the low-lying marsh beyond the downstream terminus of the Ebner Coulee diversion works, maintain an outlet through this area with sufficient capacity to carry the combined flows from Miller and Ebner Coulees.

i. At least annually inform affected interests that the channel improvements will not provide complete flood protection.

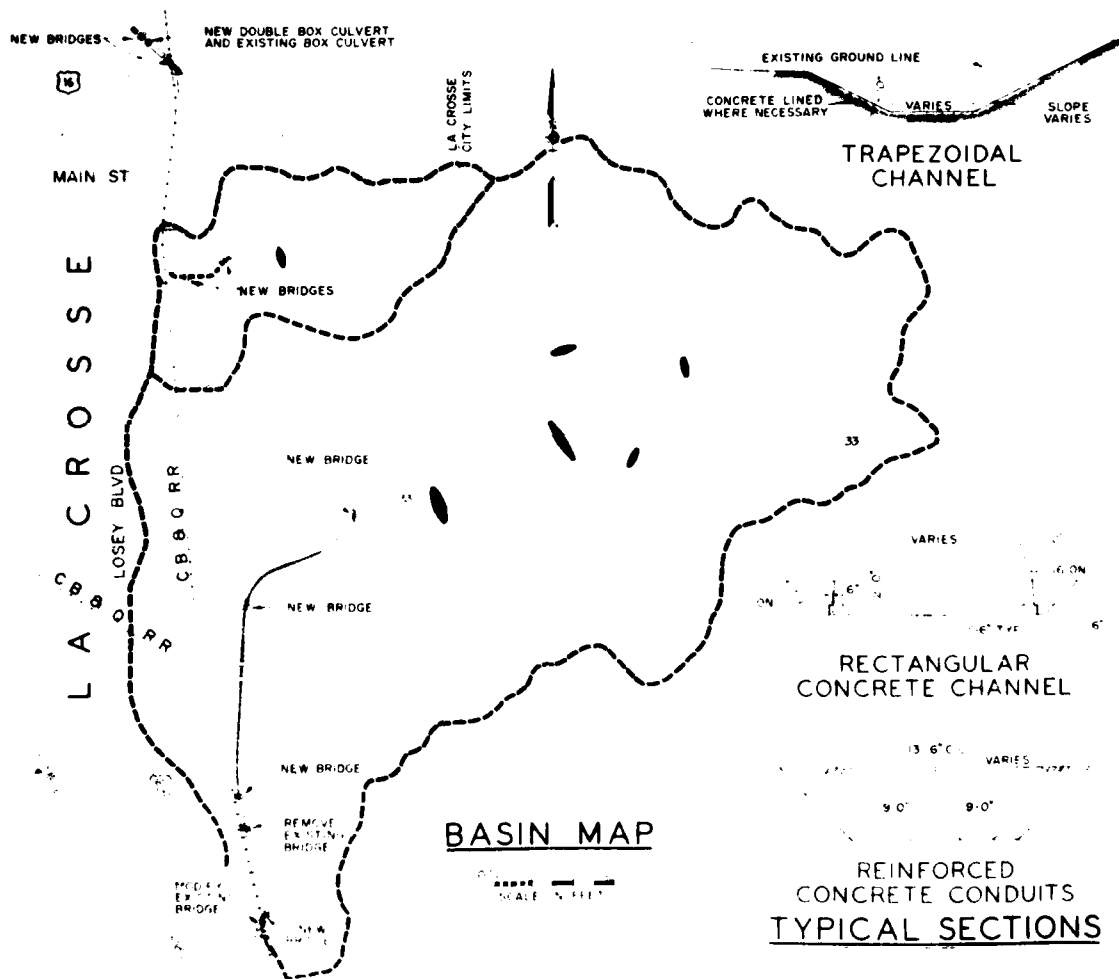
#### DESCRIPTION OF AUTHORIZED PLAN

The authorized plan from the 1967 survey report is shown on plate 1 and on the following figure. The authorized plan provides for increasing the capacity of State Road Coulee by deepening and enlarging the downstream portions of the existing channel, increasing the capacity of Ebner Coulee by deepening and enlarging a portion of the downstream channel and diversion of flood flows through twin concrete conduits to an enlarged Miller Coulee channel and thence to the La Crosse River. The plan would include drop structures on both coulees, several bridge modifications, and utility relocations. The plan would provide protection from flood flows up to those having about a 2-percent chance of occurring during any single year. Pertinent data for the authorized plan are given in the table below. The plan is described more fully in the following paragraphs.

## 23

TRAPEZOIDAL EARTH CHANNEL  
 ———— TRAPEZOIDAL CONCRETE LINED CHANNEL  
 - - - - RECTANGULAR CONCRETE CHANNEL  
 I REINFORCED CONCRETE CONDUITS  
 DROP STRUCTURE OR STILLING BASIN

 FLOOD CONTROL DAM



## LA CROSSE WISCONSIN

U S ARMY ENGINEER REGIMENT, 101ST AIRBORNE CORPS OF ENGINEERS

Pertinent data for authorized plan

EBNER COULEE:

Hydraulics and hydrology:

Total drainage area <sup>(1)</sup>	1.0 square mile
Design flood frequency	2-percent chance
Design flood flow <sup>(2)</sup>	Varies from 1,070 cfs to 2,140 cfs

Principal items of work:

Channel modifications:

Rectangular concrete channel, 16-foot width	1,925 feet
Diversion works - two 9-foot-diameter conduits, 50-foot excavation top width	4,850 feet
Trapezoidal earth channel (Miller Coulee), 28-foot bottom width, about 100-foot top width	900 feet
Rectangular concrete channel (Miller Coulee), 30- to 60-foot bottom width, 40- to 80-foot top width	440 feet
Utility relocations (water, sanitary, and storm sewer)	8
Removal and replacement of bridges	4
Concrete culverts (8- by 8-feet) under Highway 16	2
Chain link fence	3,920 feet
Lands, fee title	4.8 acres

STATE ROAD (PAMMEL CREEK):

Hydraulics and hydrology:

Total drainage area	6.0 square miles
Design flood frequency	2-percent chance
Design flood flow	Varies from 4,000 cfs to 5,100 cfs

Principal items of work:

Channel modifications:

Trapezoidal concrete channel, 10-foot bottom width, 50- to 70-foot top width	3,820 feet
Trapezoidal concrete channel, 24-foot bottom width, 55- to 75-foot top width	7,800 feet
Rectangular concrete channel, 70-foot width	600 feet
Trapezoidal earth channel, 130-foot bottom width, 150- to 190-foot top width	1,720 feet
Drop structure at upstream end	20 feet wide by 29 feet long
Stilling basin at change in channel slope	Transition from 10-foot to 24-foot channel
Utility relocations (water and sanitary)	5
Removal and replacement of bridges	6
Chain link fence	2,700 feet
Lands, fee title	62.5 acres

(1) Drainage area of Ebner Coulee at Farnam Street (entrance to storm sewer).

(2) Includes flow of Miller Coulee where applicable.

## STATE ROAD COULEE

With the authorized plan, modifications to State Road Coulee would generally follow the present alignment downstream from the vicinity of Hagen Bridge, as shown on plate 2. Little disruption to existing residential development in the area would result. The present channel would be deepened and enlarged. Between Hagen Bridge and the Burlington Northern railroad bridge, the improved channel would have a trapezoidal shape and be lined with 12 inches of concrete for protection from anticipated high velocities. This 11,800-foot-long channel would have 2 on 1 side slopes with a bottom width varying from 10 feet in the upstream reaches to 35 feet near the railroad bridge. Upstream coulee flows would enter the improved channel through a drop structure at station 139+50 near Hagen Bridge. A stilling basin at station 87+00 would reduce high velocities caused by steep channel slopes in the upper reaches of the improved channel.

Downstream from the trapezoidal channel, a rectangular concrete flume, 600 feet long, would extend under the railroad bridge and the adjacent U.S. Highways 14 and 61 overpass. This 70-foot-wide channel would also carry flows through two horizontal curves. Downstream from the concrete flume, an enlarged unlined channel would carry flows to the Mississippi River.

The channel capacity would vary from 4,000 cfs upstream from station 87+00 to 5,100 cfs downstream from the railroad bridge. The present levees would be removed and the channel dropped sufficiently to enable surface runoff from the low-lying adjacent floodplains to drain directly into the channel. Localized areas below the top of the proposed flume would be filled to permit drainage toward the channel. The bottom of the concrete-lined channel would be placed on a natural sand foundation, except in the upstream end where peat would be encountered. This peat would be replaced with granular material before construction of the new channel. (Detailed soil boring data are contained in appendix A of the November 1967 Survey Report.)

## EBNER COULEE

Because of the highly restricted outlet for Ebner Coulee, the approximately 8,600-foot-long authorized diversion works would provide for diverting design flows from the coulee channel northward along the alignment shown on plate 3. At the upstream terminus of the diversion works, near the base

of the bluff, flows from the channel would enter a box-inlet drop structure leading into a 16-foot-wide rectangular concrete flume. The flume would follow an alignment adjacent to and north of the present channel downstream to the Burlington Northern railroad tracks. From this point, flow would be directed north through two 9-foot diameter, reinforced-concrete conduits along a route parallel to and east of the railroad tracks to the junction with Miller Coulee at station 16+65. A drop structure at this point would pass the combined flows under a proposed new railroad bridge and into an enlarged portion of the Miller Coulee channel downstream to U.S. Highway 16. Flows would then be conveyed by a rectangular concrete-lined flume discharging into a low-lying marsh adjacent to the La Crosse River. The capacity of the diversion works would be 1,070 cfs above the junction with Miller Coulee and 2,140 cfs below the junction. The existing channel adjacent to and parallel with the railroad tracks and also the existing coulee outlet at the Farnam Street storm sewer would be preserved as an integral part of the project. Runoff originating within the watershed below the upstream terminus of the diversion works and in excess of the capacity of the existing storm sewer system in this area would continue to flow overland into the existing channel and then into the Farnam Street storm sewer that runs to State Road Coulee.

The only developed area along the diversion route in the authorized plan was a one-block stretch between Cass and Main Streets where backyards of homes abut the railroad right-of-way. However, ample space was available between the houses and railroad tracks in this reach to construct the twin conduits without seriously encroaching upon either railroad or residential property. A small, old building facing Cass Street within this block would have been removed in the authorized plan. Since authorization, additional development has taken place along the proposed diversion route between Market and Main Streets. The authorized plan would now require the removal of two buildings in this area: (1) a four-plex that faces Cass Street and (2) a garage located about halfway between Cass and Main Streets. North of Main Street, the diversion conduits would continue parallel to the railroad tracks through a golf course to the junction with Miller Coulee at the northwest corner of the golf course.

The upstream flume would be constructed on a layer of granular material placed over the existing clay. The conduits would be constructed on a moderately firm, sand foundation. A layer of peat located under the downstream flume would have to be replaced with suitable granular material.

#### BRIDGES

The authorized project channel modifications and diversion works would require construction of eight street or highway bridges, a new railroad bridge, modifications to a railroad bridge, and an addition to an existing box culvert under U.S. Highway 16 at Miller Coulee. One of the eight highway bridge sites identified for modification in the authorized plan (Ward Avenue Bridge, station 101+30) has been deleted from plate 7, Recommended Bridges, because the city of La Crosse constructed an adequate bridge at this location in 1980. A farm bridge on State Road Coulee recommended for replacement in the authorized plan (station 19+65) is now scheduled for removal and replacement with an at-grade railroad crossing. All costs associated with alteration, modification, or reconstruction of street or highway bridges were allocated to non-Federal interests. The alteration and construction of railroad bridges would be accomplished by the railroad company at Federal expense.

#### RELOCATIONS

The authorized project would involve several modifications to existing storm sewer, sanitary sewer, and water lines. No modification or relocation of private utilities is anticipated. The channel improvement on State Road Coulee would require an extension of three 30-inch reinforced-concrete discharge conduits from an existing storm sewer lift station near station 61+00 into the relocated channel at this location. Inverted siphons would be installed at stations 101+50 and 130+00 to pass a 10-inch and an 8-inch sanitary sewer, respectively, under the proposed channel. Water line crossings under the proposed channel at stations 55+00 (12-inch line) and 101+00 (8-inch line) would be lowered.

For the Ebner Coulee diversion works, existing 18-inch and 24-inch storm sewers at stations 44+00 and 50+00, respectively, would be drained into the proposed reinforced-concrete conduit and regulated with gate-controlled outlets. A 48-inch storm sewer main on the railroad right-of-way would outlet into the proposed drop spillway at station 16+65. At station 5+00 an existing 8-inch sanitary sewer main would be lowered to provide adequate



coverage against freezing. An inverted siphon would also be installed at station 44+00 to pass a 12-inch sanitary sewer under the proposed waterway. Water lines passing under the proposed channel at stations 5+00 (6-inch line), 40+00 (20-inch line), and 55+00 (8-inch line) would have to be lowered.

## CURRENT WATER AND RELATED LAND RESOURCE NEEDS AND DEVELOPMENT OBJECTIVES

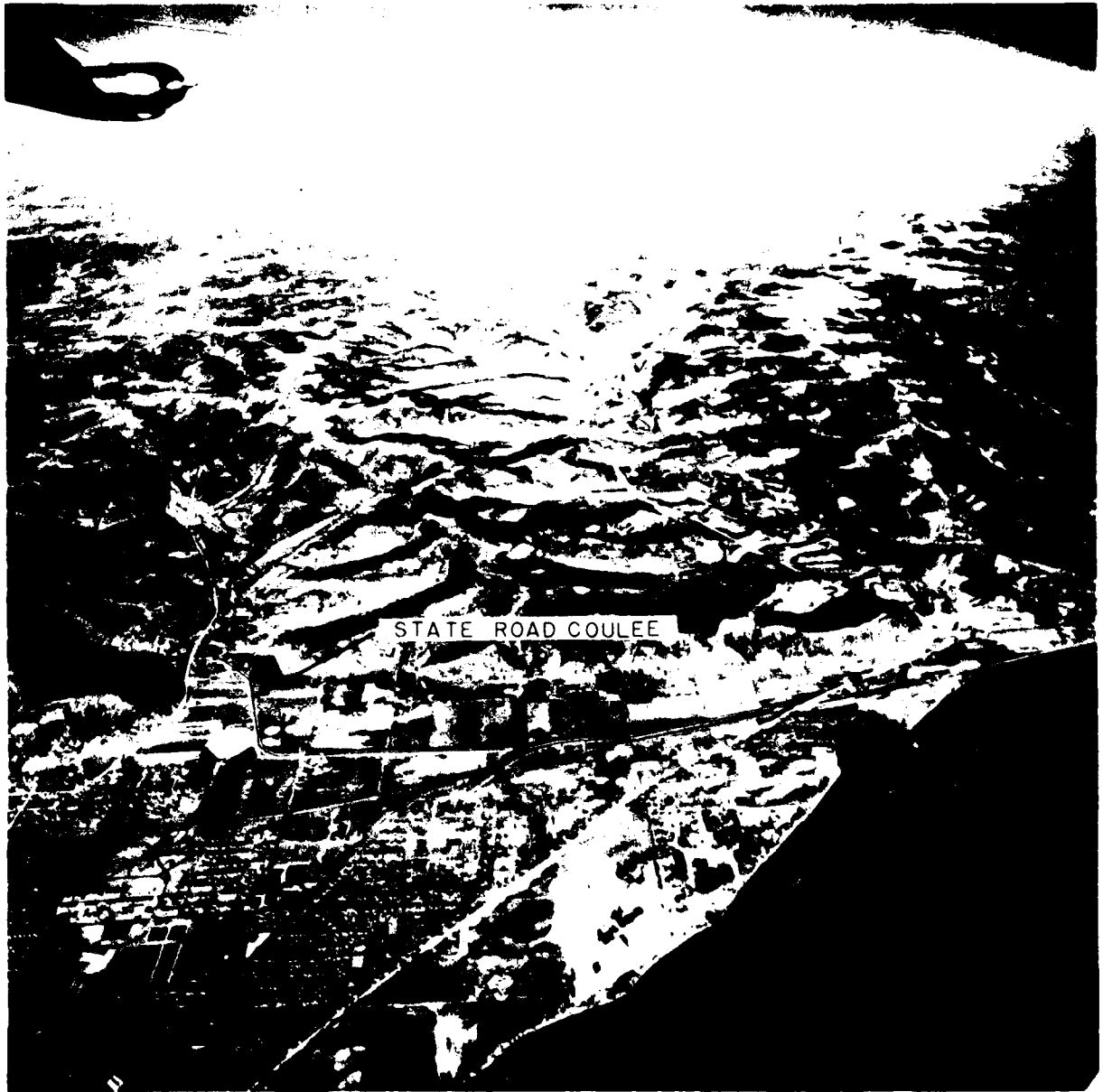
### GENERAL

This section presents a discussion of current flood damage reduction, land resource management, water supply, water quality, recreation, fish and wildlife, public health and safety, and aesthetic and cultural needs within the State Road and Ebner Coulee area. Anticipated rates of alleviating identified needs by various current Federal, State, county, city, and private programs are also discussed on the basis of available information. The authorized improvements concentrate on meeting flood control needs within the study area for the 2-percent (50-year) flood level of protection. In contrast, this phase I report concentrates on meeting flood control needs and other identified water resource needs incidental to development of the best overall flood damage reduction plan for the 1-percent or 100-year flood level of protection. Certain water and related land resource needs can be met by funding of specific programs under jurisdiction of other government agencies.

### FLOOD DAMAGE REDUCTION

Under present conditions, overbank flows and corresponding residential damages begin when the flow below Hagen Bridge on State Road Coulee exceeds approximately 1,100 cfs. Similarly, flood damages occur from Ebner Coulee when the flow exceeds the storm sewer capacity of about 130 cfs at Farnam Street. Periodic flooding also occurs in low-lying areas along the lower reach of State Road Coulee where runoff is trapped behind the present dikes. The area within the limits of the authorized plan and subject to inundation by the 1-percent chance flood includes about 630 acres. The extent of this potential flood area is shown on plate 5-1.

Past flood damages (before 1960) were not as extensive because no major urban development had taken place in the flood prone areas. Aerial photographs taken in 1951 indicate less than 100 structures were located in the flood area described above. The following 1951 photograph indicates the development in State Road Coulee at that time.



EXISTING DEVELOPMENT IN THE STATE ROAD COULEE AREA IN 1951

As of October 1980, 1,503 residential units were subject to damage from the standard project flood; 1,116 of these were subject to damage from the 100-year flood. The largest flood on State Road Coulee in recent history occurred in August 1959, and the peak discharge is estimated to have a recurrence interval of once in 100 years. The total runoff volume, however, was estimated to be less than that expected for a volume frequency of once in 100 years. The urban development in the floodplain at that time was considerably less than the current development.

Damages to residential properties constitute about 91 percent of the flood damage potential in the study area. These damages include physical damages to homes, other real property improvements, and personal property and costs of emergency quarters and reoccupation. Total average annual flood damages to residential properties at October 1980 price levels and conditions are estimated at \$2.908 million.

Damages to commercial establishments constituted about 8 percent of the total annual flood damages in the study area. These losses include physical damages to land, buildings, equipment, and stocks of merchandise as well as the loss of wages and business profits and the costs of emergency protection. Average annual commercial damages are estimated at \$253,000.

The remaining flood damages in the study area (less than 1 percent) are to public properties. These losses include physical damages to streets, bridges, and walks. Additional costs incurred by the public during flood emergencies include flood fighting; disaster relief; additional travel on detours; and extra work for police, fire, and military patrols. Total average annual damages to public properties are estimated at \$11,000.

Total average annual flood damages in the study area, recognizing future growth and development, are estimated at \$3.154 million. Detailed evaluation of projected flood damages is given in the following table.

Total average annual damages		
Item	State Road Coulee	Ebner Coulee
Area within La Crosse city limits:		
Residential	\$2,052,800	\$800,400
Commercial and industrial	83,300	168,900
Public	<u>9,200</u>	<u>1,400</u>
Total La Crosse	2,145,300	970,000
Area within Shelby Township:		
Residential	36,900	0
Commercial	700	100
Public	<u>500</u>	<u>0</u>
Total Shelby Township	38,100	100
Total damages	2,183,400	970,700

#### LAND RESOURCES MANAGEMENT

Determination of existing and future land use needs is essential to proper land resources management. Present (1976) land usage within the urban La Crosse area is given in the following table. Urban or developed land use has been constricted by a topography of pressing high bluffs and frequently flooded lowlands. The photograph on page 9 indicates the rugged topography east of the La Crosse area. An unplanned pattern of development in the past has resulted in congestion and conflict between incompatible land uses. Urban area growth has utilized all contiguous land for development except for small plots of less desirable vacant land in the city of La Crosse. Vacant developable land is also located in the La Crosse River floodplain and on French Island. Additional developable flood-free land is farther removed in areas north and east of the city of Onalaska. The primary use of developed land at La Crosse is for transportation and utilities followed by residential development.

Existing (1976) land use, La Crosse study area

Subdivision of study area (usage)	City of					Town of			Town of		Shelby		Total		Percent of total de veloped are
	La Crosse (ac)	City of Onalaska (ac)	Town of Onalaska (ac)	Town of Medary (ac)	Town of Campbell (ac)	Medary (ac)	Campbell (ac)	Shelby (ac)	Shelby (ac)	Shelby (ac)	Shelby (ac)	Shelby (ac)	study area (ac)	study area (ac)	
Commercial	490	26	29	38	49	72	704	0.9	5.0						
Industrial	261	45	57	72	4	11	450	0.5	3.0						
Transportation and utilities	2,444	339	632	470	421	529	4,835	5.9	35.0						
Residential	2,360	482	628	439	376	591	4,876	5.9	35.0						
Public and semipublic	343	95	24	22	139	52	675	0.8	5.0						
Parks and recreation	1,026	52	80	291	21	876	2,346	2.9	17.0						
Total urbanized	6,924	1,039	1,450	1,332	1,010	2,131	13,886	16.9	100.0						
Agriculture	0	386	21,474	9,916	253	13,128	45,157	55.0	-						
Extractive mining	0	2	17	43	-	33	95	0.2	-						
Commercial forest	0	0	0	-	-	-	-	-	-						
Vacant land	1,255	159	3,092	350	1,651	1,860	8,367	10.2	-						
Marshland	344	130	-	-	-	779	1,253	1.5	-						
Open water	1,009	407	4,840	100	5,184	1,739	13,279	16.2	-						
Total undeveloped	2,608	1,084	29,423	10,409	7,088	17,539	68,151	83.1	-						
Total land area	9,532	2,123	30,873	11,741	8,098	19,670	82,037	100.0	-						

SOURCE: Candebub, Fleissig and Associates, Background Report: General Plan for the La Crosse Area, January 1969 (as updated by the La Crosse City Planning Department).

Land needs for future development to the year 1995 were updated by the La Crosse Area Planning Committee in "General Plan for the La Crosse Area: Land Use - Transportation" (December 1977). Anticipated additional land needed by the year 1995 includes 2,101 acres for residential development, 837 acres for industrial expansion, and 645 acres for trade and services.

Urban development for the State Road and Ebner Coulee watersheds has occurred in the valleys behind the bluffs overlooking La Crosse and in the broad flatlands at the base of the bluffs. Increasingly, however, development has occurred up on the steep bluff faces and valley slopes and on the ridge land along County Trunk F. (County Trunk F generally parallels or constitutes the northernmost drainage area boundary for Ebner and State Road Coulees, lying north of Highway 33 (see plates 1 and 3).) Thirty-one percent of Ebner and State Road Coulees is urbanized.

Since 1968, 145 acres of agricultural land in State Road Coulee and 18 acres in Ebner Coulee were converted to urban uses. Of this acreage, 138 acres were on the uplands. This trend toward developing upland areas into residential land will mean increased runoff flows and higher flood risks.

A large residential development is in the planning and initial construction stages just east of the junction of State Road Coulee and Highway 14-61. The development involves about 50 acres, of which 40 acres is grassland and 10 acres is wooded.

Land resource management of agricultural areas in the two watersheds consists of soil and water conservation practices by individual agricultural landowners. Eighty percent of the 540 acres of cropland in the State Road Coulee watershed and the entire 34 acres of cropland in the Ebner Coulee watershed are considered adequately managed by means of proper crop rotations and contour-stripped upland crop fields. Only 5 percent of the State Road Coulee watershed and 1 percent of the Ebner Coulee watershed

are pastured. Both watersheds are characterized by large areas of woodland. Sixty-three percent of the Ebner Coulee watershed and 52 percent of the State Road Coulee watershed are wooded or being returned to woodland. All of the wooded acreage is considered to be adequately managed. Therefore, very little runoff reduction could be accomplished by further upland management without extensive use of earthen dams. One small earthen dam has been constructed in Ebner Coulee.

Other land uses and management needs for various recreation activities, drainage, and fish and wildlife are discussed in other paragraphs of this section concerned with current water and related land resource needs and development objectives.

#### IRRIGATION

Irrigation practices play a very minor role in the treatment of both State Road and Ebner Coulees. Irrigation for agricultural purposes is not practiced and future demands are not anticipated to be significant. Urban use consists of water for lawns. Existing and future city and individual water supplies will be more than adequate to meet this demand.

#### DRAINAGE

Drainage practices in the State Road and Ebner Coulee watersheds are geared toward handling urban stormwater. Agricultural drainage practices are minor since cropland and pastureland constitute only a small portion of the two watersheds. A few small bottomland fields in State Road Coulee could benefit from tile drainage but this would involve only a few hundred feet of improvement.

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The lower portions of both watersheds are served by the La Crosse municipal stormwater system consisting of a grid of sewers varying in size from 12 to 78 inches in diameter. The upper, less urbanized portions of the watersheds use the State Road and Ebner Coulee channels for stormwater drainage. The State Road channel continues through the urban La Crosse area to the Mississippi River. Ebner Coulee, however, enters the La Crosse storm sewer system through a 48-inch storm sewer near Farnam Street and the Burlington Northern railroad tracks. Ebner Coulee flows continue on to the main 72-inch storm sewer collector, which parallels the tracks before emptying into State Road Coulee downstream of the Highway 14 and 61 bridge. Modifications to Ebner Coulee for flood control would relieve the 72-inch storm sewer collector serving the La Crosse area in and around the Ebner Coulee watershed.

#### WATER SUPPLY

The present municipal and industrial water supply for the lower portions of State Road and Ebner Coulees is obtained from the La Crosse municipal wells and water supply distribution system. The distribution system in the State Road Coulee currently extends to tributary coulees north and south of Highway 33 up to Hagen Road (the upstream limits of the authorized flood control project for State Road Coulee). Residential and agricultural developments upstream of this system obtain water from individual wells. The water distribution system in Ebner Coulee includes the lower portion of the coulee generally downstream of 29th Street. The sparse residential development upstream in the steeper and more rugged portion of the coulee obtains water from individual private wells. The "1990 La Crosse Area Water Plan" calls for retaining the three existing city wells and constructing 16 new high-service wells and additional storage facilities. Thus, future water supply demands will probably remain independent of surface water supplies.



## WATER QUALITY

The quality of groundwater is generally good but surface waters of State Road and Ebner Coulees show evidence of pollution. Surface water flows in Ebner Coulee are intermittent, only existing from the occurrence of rainfall or snowmelt runoff. As only 7 percent of the Ebner Coulee drainage area is used for agriculture and only 30 percent is urbanized with the remainder being woodland, the quality of runoff is usually typical of undeveloped areas. The steeply sloped channel results in high velocity flow during runoff periods and causes some erosion and sediment runoff from the exposed bedrock consisting of sandstone, shale, and limestone at various elevations in the coulee. The extreme upper level of the coulee consists of wind-deposited silt (loess).

During low-flow periods, most of the water in State Road Coulee comes from groundwater. A continuous flow exists and the water is extremely hard. Total hardness values range from 270 mg/l (milligrams per liter) to 340 mg/l. Nitrate levels of the flow in the lower portions of the coulee range from 4.0 ppm to 4.7 ppm, depending on location and conditions. These high nitrogen levels are apparently caused by seepage from septic systems or leaching from surrounding soils. The streamflow formerly contained high levels of fecal coliform bacteria. This problem has largely been eliminated by the installation of sanitary sewer systems in residential areas in recent years. The resulting change to the sewer system from the septic tank and drain field systems has improved overall water quality. However, water quality will continue to suffer adverse effects from upstream agricultural areas (16 percent of the coulee drainage area is agricultural land) and from stormwater runoff from residential areas.

A need for further improvement of water quality exists. Programs for dealing with existing causes of water quality problems are under the jurisdiction of the Wisconsin Department of Natural Resources, the Soil Conservation Service (agricultural runoff and soil conservation practices), and the Environmental Protection Agency. Construction agencies such as the Corps of Engineers can also contribute to improved water quality with wise structural and nonstructural improvements.

## RECREATION

The La Crosse urban area has sufficient existing facilities to meet most of the basic land-based recreation needs. However, facilities for bicycling, skiing, hiking, nature walking, bird watching, and wildlife photography are limited. A 1972 park and recreation planning study for the La Crosse area completed by the La Crosse City Planning Office focused on anticipated recreation needs.

State Road and Ebner Coulees provide the type of terrain suitable for meeting the recreation needs described above. Thus, recreation studies were conducted in conjunction with the flood control studies to determine the recreation needs that can be incorporated into the flood control studies. Appendix 2 provides details of the recreation facilities and opportunities for the La Crosse area and specifically for the State Road and Ebner Coulee watersheds.

The authorized plan did not include a recreational resource plan, and none has been included in the recommended plan presented in this report. However, the recreational resource plan described in appendix 2 involves project lands and can be added to the project during preparation of the Phase 2 General Design Memorandum. Local interests would have to endorse the recreational resource plan and agree to share 50 percent of the estimated cost of the plan. The total costs for the recreational plan are estimated at \$109,400, making the local share \$54,700.

## FISH AND WILDLIFE

Wildlife habitat is sparse in the State Road and Ebner Coulee area because of extensive urban development in the coulees and alteration of the coulee channels for drainage and flood control. The steeply sloped upper portions of the coulees are less developed and support more wildlife. Moderately valuable floodplain forest and reed canary grass marsh habitat exists along the lower reaches of State Road Coulee below U.S. Highways 14 and 61. A diverse array of wildlife species use this floodplain area.

Wildlife habitat could be improved by incorporating trees, shrubs, and grasses with flood control measures involving channels, levees, or evacuation of the floodplain. This could result in the establishment of a narrow corridor between the upper portions of the coulees and their respective outlets to the Mississippi River and La Crosse River floodplains.

Because of poor water quality and lack of sufficient flow, the fish population of State Road Coulee is almost nonexistent. Ebner Coulee is dry except during periods of rainfall or snowmelt. Improvement of water quality in State Road Coulee would benefit fish populations somewhat, but the extremely small flow would still be a limiting factor.

#### PUBLIC HEALTH AND SAFETY

The health and safety of residents in the study area are directly affected during major flood threats. No known flood-related deaths have occurred, but the potential for loss of life has been greatly increased because of the amount of urban development in recent years on the State Road and Ebner Coulee floodplains. This potential is further compounded by the flash flood nature of runoff, which is due to the steeply sloped, rugged terrain of the upper portions of State Road and Ebner Coulees.

Flood flows are fast moving, with velocities up to 20 feet per second in the floodplain areas upstream of Ward Avenue on State Road Coulee and 29th Street on Ebner Coulee. The flow velocities are greatly reduced, however, as the floodwaters spread out onto the relatively flat terrain in downstream areas.

The safety of residents is affected by flooded residences and the resulting potential for electric shocks and injurious falls and by the risk of movement over flooded thoroughfares. Public health problems include stormwater overflow into basements, contamination of private water supplies, and increased fire potential. Public health and safety considerations have been incorporated into the analysis of the alternative flood control solutions. To ensure that adequate public health standards are incorporated into the recommended plan, the project will be fully coordinated with appropriate public health agencies during phase II studies.

## AESTHETIC AND CULTURAL AREAS

State Road and Ebner Coulees originate in the high bluffs overlooking the Mississippi River. Natural erosion has formed these coulees from what was once a fairly level plateau. This type of area with a steep relief into the Mississippi River valley is generally considered aesthetically valuable.

The lower portions of the coulee drainage areas extend across a glacial outwash terrace. Since the early 1950's this terrace has been continuously developed into residential areas. The State Road and Ebner Coulee streams in the terraced area have been straightened and leveed by local interests in an attempt to control drainage and flooding. The analysis of alternative solutions considers the aesthetics of the bluff areas (for the upstream reservoir alternative) and incorporates landscaping measures for channel modification and levee alternatives.

In accordance with Section 106 of the National Historic Preservation Act of 1966, the National Register of Historic Places has been consulted. As of 12 November 1980 only one property listed on the National Register would be affected by the State Road Coulee flood control project - the Overhead archeological site located near the lower terminus of the channel modification alternative.

Two cultural resource surveys have been conducted within the project area in connection with this study: (1) University of Wisconsin-La Crosse, 1975, and (2) Gallagher, 1980. The latter survey was designed to determine the extent to which the Overhead site would be affected by the project. In addition, adjacent areas were surveyed for unreported sites. The results of the survey indicated that the National Register boundary of the Overhead site is incorrectly located. Although a number of the lower terminus alignments impinge on the present boundary, only one alignment would actually have an adverse effect on the site. These impacts are discussed in detail in the EIS.

Two previously unreported sites were located during the 1980 survey. Both are located in the lower terminus area. One is a prehistoric site dating to approximately the same period as the Overhead site. The other site is a historic site, possibly dating to the mid-1840's. The prehistoric site is the only site in the lower terminus area that may be adversely affected by the proposed channel. This site will be intensively tested during phase II advance engineering and design to determine its eligibility for the National Register. If this site is found to be eligible, the comments of the Advisory Council on Historic Preservation will be sought and appropriate action will be taken in accordance with 36 Code of Federal Regulation, Part 800.

## INVESTIGATIONS

### PREAUTHORIZATION

The authorized State Road and Ebner Coulees project was based on field instrument surveys; aerial topographic maps; subsurface explorations; flood damage appraisals; and office analysis of the hydrologic, hydraulic, design, environmental, and economic factors involved. Foundation conditions at the site were analyzed on the basis of data obtained from soil borings. Economic analyses consisted of determining average annual flood damages and benefits in flood prone areas from data collected in the field and from results of hydrologic and hydraulic studies. Structural analyses were made of all major design features. Land use, fish and wildlife conservation, water supply and water quality control, and highway transportation facilities were studied in cooperation with other Federal and State agencies. During preauthorization studies, several public meetings and meetings with affected local groups were held to obtain their views on flood and related problems and possible solutions to the problems (see appendix 1).

## POSTAUTHORIZATION

Phase I general design memorandum investigations were limited to studies necessary to ensure that the authorized plan, or a modification thereof, would reflect current public desires and meet current standards for national economic development, environmental quality, regional development, and social well-being. These studies included the following:

a. Economic studies to update flood damages to present conditions and price levels.

b. Engineering studies to reflect current design criteria and hydrologic conditions and to provide an up-to-date estimate of project costs.

c. Economic, environmental, and social assessments of all practical alternative flood control plans including nonstructural and structural measures and combinations of these measures. (Social and environmental assessments were not as detailed for Ebner Coulee because of an apparent lack of project feasibility.)

d. Environmental and archeological studies under contract with an educational institution to obtain an environmental inventory of the watersheds and to locate and identify areas which could be affected by potential alternative flood control plans. These studies provided a basis for evaluating environmental impacts of alternatives and preparing an environmental impact statement.

e. Project formulation studies to determine the optimum flood control plan by analyzing differences among the potential alternatives and the corresponding effects of trade-offs among the national economic development, environmental quality, and social well-being objectives.

f. Recreation analyses to provide a current estimate of recreation demand and the need for recreational opportunities and to reassess project related recreation development.

The postauthorization studies were conducted during two separate time periods. The principal evaluation was completed between 1974 and 1976, with a follow-up evaluation taking place from 1978 to 1980. The gap between studies resulted when local interests withdrew support and the study was suspended for several years.

The results of the first period of study were discussed in detail with a citizens committee formed of representatives from principal concerned areas within the project area. The committee encouraged and provided for public involvement by holding several public meetings to examine current needs and concerns and review the results of the studies.

The second period of study involved less public involvement at the local level, concentrating on reevaluation of the selected plan and other alternatives developed in 1976. This second effort included resolving environmental issues and updating costs and benefits for alternatives because of changes in the floodplain boundaries, additional floodplain development, and an increase in the interest rate. This second effort resulted in a recommendation not to construct the Ebner Coulee portion of the project because of economic infeasibility.

## EVALUATION CRITERIA

### GENERAL

The principal purpose of plan formulation studies conducted for this phase I report is to develop a plan which will provide the best use, or combination of uses, of water and related land resources to meet foreseeable short- and long-term needs of the State Road and Ebner Coulee watersheds. In accordance with the Principles and Standards for Planning Water and Related Land Resources, as published in the Federal Register, Volume 38, No. 174, Part III, dated 10 September 1973, national economic development and

environmental quality are considered the two principal planning objectives. Additional planning objectives specific to the study area will be identified and used in the plan formulation process. Social well-being and regional economic development are also important planning accounts. The viable alternative plans to solve current and prospective water and related land resource problems and needs of the study area are evaluated and examined with the goal of increasing national economic gains, enhancing the quality of the environment, and improving social well-being and regional economic gains.

#### TECHNICAL CRITERIA

The following technical criteria were adopted and used as a basis for evaluating and comparing alternative plans:

- a. The plan must be technically feasible to implement.
- b. The plan should be complete within itself and not require additional future improvements.
- c. The optimum scale of project development should be provided by analyzing the effects of trade-offs between national economic development and environmental quality.
- d. The plan should insure against worsening upstream or downstream flood conditions.
- e. A project should be designed to protect against a flood having a recurrence interval of not less than once in 100 years (a 1-percent chance flood) in urban areas.
- f. Standard project flood protection will be considered where feasible.



## NATIONAL ECONOMIC DEVELOPMENT

The national economic development criteria applied in plan formulation are in accordance with the "Principles and Standards" prepared by the Water Resources Council and adopted in 1973 and modified in 1979. The "Principles and Standards" identify two national objectives (national economic development and environmental quality) and establish a system of four accounts by which alternatives can be compared. Economic criteria used in evaluating each alternative plan include the following:

- a. Tangible benefits must exceed project economic costs.
- b. Each separable unit or purpose must provide benefits at least equal to its costs.
- c. The scope of the proposed development must be scaled to provide maximum net benefits. However, proposed developments providing less than the economic optimum can be recommended if appropriate gains in environmental quality and social well-being can be shown.
- d. No more economic means, evaluated on a comparable basis, would accomplish the same purpose(s) and be precluded from development if the plan were undertaken. This limitation applies only to those alternative possibilities that would be physically displaced or economically precluded from development of the project were undertaken.
- e. The plan must fit integrally into an overall plan for water and related land resource management and development for the Upper Mississippi River basin.

Average annual benefits and costs are based on an interest rate of  $7 \frac{3}{8}$  percent and price levels and conditions prevailing in October 1980. Water Resources Council regulations established in 1969 provide for application of the  $3 \frac{1}{4}$ -percent interest rate on all authorized projects where "satisfactory assurance to pay the required non-Federal share of the project costs" was received from project sponsors by 31 December 1969.

Such assurance was received from La Crosse County by letter dated 10 November 1969, but subsequent lack of local support in 1976 led to inactivation of the project and loss of the 3 1/4-percent interest rate. The current interest rate of 7 3/8 percent now applies to the project since it was reactivated in November 1978. An economic life of 100 years was used to evaluate all alternative plans of improvement.

#### ENVIRONMENTAL QUALITY

Environmental factors used in the plan formulation and evaluation process included the following:

- a. Management, protection, enhancement, or creation of areas of natural beauty and human enjoyment.
- b. Management, protection, and enhancement of especially valuable or outstanding archeological, historical, biological, and geological resources and ecological systems.
- c. Enhancement of quality aspects of water, land, and air while recognizing the need to harmonize land-use objectives in terms of productivity for economic use and development with conservation of the resource.
- d. Study, development, and description of appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.
- e. Evaluation of the environmental impact of any proposed action, the adverse environmental effects which could not be avoided should a proposal be implemented, and the alternatives to the proposed action.
- f. Preservation and enhancement of social, cultural, educational, and historic values of the area.
- g. Preservation of aesthetic values of the area.
- h. Provision of adequate water and related land-based recreation opportunities.

## SOCIAL WELL-BEING

Social well-being factors considered throughout the study include the following:

- a. Loss of life potential and hazards to public health and safety.
- b. Effect on local community patterns.

## REGIONAL ECONOMIC DEVELOPMENT

Factors considered which affect the regional economic development of the area include most of the factors described in the national economic development account and also the following:

- a. Effect on the area tax base of taking private lands and placing them in public ownership.
- b. Employment changes in the area as a result of the project.
- c. Expenditures of nonarea residents in the study area.
- d. Disruption of desirable community and regional growth.

## SPECIFIC PLANNING OBJECTIVES

In the study of the flood and related problems of the State Road and Ebner Coulee watersheds, the following specific planning objectives are identified in terms of resource management needs. The objectives are to:

- a. Reduce economic losses from urban flooding in the State Road and Ebner Coulee floodplains during the 1980-2030 period of analysis. Although the two floodplains overlap in some areas, the State Road Coulee floodplain extends generally from the Hagen Road bridge to the Burlington

Northern bridge on State Road Coulee, and the Ebner Coulee floodplain extends from Cass Street on the north to Ward Avenue on the south.

b. Minimize lands required for flood control in the La Crosse area during the 1980-2030 period of analysis. The lands remaining for future growth and development of the La Crosse area are severely limited by the rugged topography on the east, the La Crosse River on the north, and the Mississippi River on the south and west.

c. Preserve or enhance future project area aesthetics.

d. Coincide with overall land use planning needs for the La Crosse area during the 1980 to 2030 period of analysis.

e. Minimize safety hazards associated with rapid runoff and minimal warning times common to the steeply sloped State Road and Ebner Coulee watersheds for the 1980 to 2030 period of analysis.

f. Minimize future adverse effects on fish and wildlife habitat in the project area to the extent possible. This includes minimizing potential secondary impacts on the Upper Mississippi River Wild Life and Fish Refuge which is located near the downstream end of State Road Coulee.

g. Avoid or minimize future impacts on the Overhead archeological site located south of State Road Coulee and west of the Burlington Northern railroad tracks.

#### ALTERNATIVE PLANS CONSIDERED

##### GENERAL

Alternative solutions considered in this study to meet water and related land resource problems and needs, particularly with regard to flood damage reduction, were classified under three principal categories: no action, nonstructural measures, and structural measures. The extent of study given to each potential solution was established by first screening each alternative for suitability, applicability, and merit in meeting identified problems

and needs. Each alternative was tested for its technical and economic feasibility, social acceptability and capacity to preserve and, where practicable, enhance the quality of the natural and human environment. Alternative measures considered for flood damage reduction and related purposes are listed below.

a. No action.

b. Nonstructural measures.

(1) Flood warning and emergency protection.

(2) Permanent floodplain evacuation.

(3) Flood proofing.

(4) Flood insurance.

(5) Floodplain regulation.

c. Structural measures.

(1) Levee system.

(2) Channel modifications.

(3) Upstream reservoir storage.

To determine the alternative plans that contribute to the planning objectives, 12 alternative plans for flood damage reduction were considered. In addition, consideration was given to maintaining the status quo or "no action" condition. The no action condition can be considered the base condition from which to evaluate all alternative plans; it would be the condition encountered if no alternative plans were recommended. Each alternative plan is described in the following paragraphs to indicate the major effects on economic development, environmental quality, and social well-being. Summaries of the economic and environmental impacts and the social well-being and regional development parameters are presented in the

2.7

tables on pages 66 through 71. The locations of the structural alternative plans are shown on plate 4. Where possible, alternative plans were evaluated for providing protection against a 100-year flood (1-percent chance flood). Also, each alternative plan incorporates floodplain regulation for areas remaining in the floodplain as required by current Wisconsin State law. The 100-year level of protection is more stringent than the 50-year design proposed in the previously authorized plan.

#### NO ACTION - MAINTAIN STATUS QUO

Maintaining existing conditions means taking no action to alleviate potential flood problems in State Road and Ebner Coulees. Thus, the existing development would be subject to potential flood hazards threatening the health, safety, and social well-being of the people. Potential economic losses associated with existing development are estimated at \$3,154,200 in average annual flood damages. Potential damages are estimated at \$2,183,400 annually for State Road Coulee and \$970,700 annually for Ebner Coulee. The State Road Coulee study area contains 586 one- or two-family dwellings, 21 mobile homes, 12 townhouses (72 units), 17 apartment buildings (256 units), 3 commercial businesses, and 4 public facilities, plus streets, bridges, and utility lines. The Ebner Coulee study area contains 486 one- or two-family dwellings, 2 commercial businesses, and 2 public facilities. The city of La Crosse adopted a new floodplain ordinance and map which were approved by the Wisconsin Department of Natural Resources on 13 November 1980. Since adoption of the floodplain ordinance and map, any new floodplain development will be strictly controlled. Consequently, the no action plan can now be considered as being identical to plan 5 - Floodplain Regulation (on page 34).

## NONSTRUCTURAL ALTERNATIVES

Several nonstructural measures may be effective in reducing flood damages. Those evaluated for this study include: (1) flood warning and emergency protection; (2) permanent floodplain evacuation; (3) flood proofing; (4) flood insurance; (5) floodplain regulation; (6) combination of floodplain evacuation, flood proofing, and floodplain regulation; and (7) upstream land treatment.

### Plan 1 - Flood Warning and Emergency Protection

Flood warning consists of predicting the timing and magnitude of floods to allow for evacuation of flood prone areas or erection of emergency flood protective measures. The National Weather Service currently provides area officials and local news media with flood forecasts and warnings. However, both State Road and Ebner Coulees are subject to flash flooding, and the advance warning time is limited from a few minutes to about 1 hour. Only general alerts can be issued in the form of storm watches when potentially severe rainfall is forecast for the vicinity. This type of potential flood situation does not allow implementation of emergency protection measures to avoid property damage and thus the plan is not an acceptable solution to potential flood problems on State Road and Ebner Coulees.

### Plan 2 - Permanent Floodplain Evacuation

Permanent evacuation of the floodplain would involve removal and relocation of improvements from the floodplain and permanent conversion of such lands to uses less susceptible to flood damage. The plan includes evacuation of 397 single family residences, 21 mobile homes, 1 commercial business (golf course), 24 townhouse units, and 84 apartment units potentially affected by flooding from State Road Coulee and 370 residences which could be flooded by Ebner Coulee. Three sanitary lift stations and a stormwater pumping station would be flood proofed as they are

still required for development not in the floodplain areas. A La Crosse Telephone Company exchange station would also be flood proofed. Suitable locations for resettlement would be small, scattered areas in the towns adjacent to La Crosse. This plan would result in some changes to existing land use. Land currently undeveloped or used for agriculture would be required for resettlement. The evacuated land would probably be converted to park and recreation land rather than being allowed to revert to a natural state since the floodplain land would be surrounded by highly developed residential areas. First costs of floodplain evacuation are estimated to be about \$38.1 million for State Road Coulee and \$36.4 million for Ebner Coulee.

The plan does not include evacuation of 189 residences, 72 townhouse units, 172 apartment units, and 59 mobile homes within the State Road Coulee 100-year floodplain and 116 residences within the Ebner Coulee 100-year floodplain that are not damaged by flooding. The surrounding grounds may be damaged and access may be restricted during high water stages. Evacuation of these properties to eliminate access problems, safety hazards to residences, and damage to the surrounding grounds would cost an additional \$19 million.

The plan would reduce total flood damages by about 96 percent (99 percent with complete evacuation). Damages to public works, parks, and the Burlington Northern railroad tracks remaining in the floodplain would amount to \$80,000 annually. This plan would have a severe impact on future land needs for urban expansion. Land use planning studies prepared for the La Crosse Area Planning Committee indicated a scarcity of land suitable for development in the La Crosse area because of the Mississippi River floodplain to the west, the La Crosse River floodplain to the northeast, and the rugged topography to the east and south. Costs to develop any suitable land can be extremely high under these conditions. The impacts of this plan could be considerable, because the losses to current undeveloped land would most likely be greater than any gains to the area to be evacuated.



### Plan 3 - Flood Proofing

Flood proofing is a combination of structural changes and adjustments to flood prone buildings for flood damage reduction. The flood proofing plan evaluated consisted of three methods of protection. Residences that would experience flooding to unfinished basements only with the occurrence of the 100-year flood would be protected by a drain tile and sump pump system, protection of basement windows, and lateral support of concrete block basement walls. Minor seepage would still occur with this protection system. The second method would apply to residences with first floors above ground level but subject to damage. These structures would be raised sufficiently to eliminate first-floor flooding. The basements would be filled the equivalent amount that the structure is raised and new concrete floors would be provided. The basement protection system described above for homes with basement only flooding would also apply. The third method would apply to structures with finished floors below ground level. The lower levels would be protected from damage by replacing the existing concrete blocks with watertight, reinforced concrete walls and floors. The total cost of this flood proofing plan would be about \$30.5 million for structures within the State Road Coulee floodplain and about \$17.5 million for those within the Ebner Coulee floodplain.

This plan would not alleviate flood damage to streets and residential lots, access problems during high water, potential safety hazards, or minor basement seepage during high water periods. The appearance of homes raised well above surrounding street levels with additional fill placed immediately adjacent to the structures might not be considered attractive and would be the major impact on the human environment. The minor amounts of fill used in this plan would raise the potential 100-year flood level about one-half foot over existing conditions, thus limiting further filling of public and private property. The flood proofing plan would have only minor impacts on the natural environment.

#### Plan 4 - Flood Insurance

The National Flood Insurance Program under the Federal Emergency Management Agency offers insurance coverage for urban residences, businesses, farmsteads, and other buildings and their contents, up to prescribed limits. Flood insurance is available within a community when an application for community eligibility has been approved by the Federal Insurance Administration. As of the date the Federal Insurance Administration approves the application, which must include land-use control measures, flood insurance at chargeable (subsidized) rates is available on all existing and new construction within that community. Current prescribed limits for subsidized flood insurance coverages are \$35,000 for a single family residence, \$100,000 for a multifamily residence, \$100,000 for non-residential structures, \$10,000 for residential contents, and \$100,000 for nonresidential contents.

Based on current actuarial rates and Federal subsidy limitations, the total cost for complete flood insurance coverage would be about \$615,000 annually (\$370,000 for State Road Coulee and \$245,000 for Ebner Coulee). The non-Federal annual costs for State Road and Ebner Coulees would be about \$117,000 and \$70,000, respectively, including \$3,000 and \$12,000, respectively, for flood insurance program administration. The costs include estimated noninsurable damages to the lot including shrubs, trees, walks, and driveways and the estimated annual costs of satisfying the \$200 deductibles for both structural and content damage.

Flood insurance does not solve flood problems and does not reduce actual damages but merely spreads the monetary loss over a wider population sector. Average annual flood damages of \$2,183,400 for State Road Coulee and \$970,800 for Ebner Coulee would remain. Accordingly, flood insurance is neither an acceptable long-term solution to the flood problems under study nor a very suitable short-term solution because of the high costs.

#### Plan 5 - Floodplain Regulation

Measures for modifying floodplain land use and development do not control or eliminate flooding but are designed to shape floodplain development so as to lessen the future effects of floods. Such measures require adoption and use of legal tools by local governments to control the extent and type of future development permitted in the floodplain. This requires public understanding of the general flood problem, degree of risk, and various means of controlling land use. Floodplain management measures include zoning regulations, subdivision regulations, building codes, and bridge construction regulations. However, damages to existing developments rather than potential increased damages to future structures and facilities constitute the major flood problem under study. Floodplain regulations would alleviate only about 25 percent of total estimated annual damages. With floodplain regulations in effect, remaining average annual damages to existing development would approximate \$3,154,200 (\$2,183,400 for State Road Coulee and \$970,800 for Ebner Coulee).

No significant urban land use changes are anticipated because of the large amount of existing floodplain development and the limited land available for new development. Floodplain regulation would have little effect on the social well-being of the people in the area and little impact on environmental quality. Thus, although this alternative would definitely be desirable as a plan to reduce future flood damages to potentially high-damage developments in urban areas, the majority of the flood damage reduction needs of the coulees would remain. This plan should be considered as a possible supplement to other flood damage reduction plans.

#### Plan 6 - Combination of Floodplain Evacuation, Flood Proofing, and Floodplain Regulation

This plan would consist primarily of the salient features of plans 2, 3, and 5. It was considered reasonable to relocate floodplain residences subject to flooding of finished floors below the existing ground level. Businesses and those residences subject to first-floor flooding but with

floors above ground level and those with only basement flooding were considered most reasonable to flood proof. Floodplain regulations would be used to ensure that future floodplain developments would be constructed so that floods up to and including the 1-percent chance flood would not cause damage. For State Road Coulee, about 165 homes would be relocated and 225 homes would be flood proofed. In the Ebner Coulee floodplain, about 58 homes would be relocated and 343 homes would be flood proofed. This includes several homes not now in the floodplain since the minor amounts of fill used for flood proofing would raise the potential 100-year flood level about one-half foot over that which would occur under existing conditions, requiring relocation or flood proofing of several additional homes. Total first costs for this plan are estimated at about \$26.5 million for State Road Coulee and about \$15.9 million for Ebner Coulee.

Because this plan does not alter flood flows, damage to streets and residential lots would still occur, access to homes would be limited, and potential safety problems would remain. Also, the flood proofing method evaluated would allow minor basement damage. The plan would reduce total flood damages by about 89 percent, and remaining flood damages would be about \$333,000. Further efforts to reduce flood damages by flood proofing or evacuation of additional homes would be very costly compared with the reduction in remaining flood damages. Aside from physical barriers and obstructions in conjunction with flood proofing techniques and other inconveniences caused by floods, the major effects on social well-being are essentially the same as under present conditions and plan 3, which consisted of flood proofing only. The major land use change would be the evacuation of 165 residences in State Road Coulee and 58 residences in Ebner Coulee.

#### Plan 7 - Upstream Land Treatment

Land treatment practices would involve controlling runoff from urban subdivisions by small retention reservoirs, minimizing the amount of area needed for roads and parking areas, and retaining as much wooded area

as practicable. Incorporating the above practices for future urban development would minimize increased runoff flows but would not reduce existing potential peak flows. Development would decrease existing woodland areas. Currently, 52 percent of State Road Coulee and 63 percent of Ebner Coulee are wooded. Further, development is now occurring on land having a 20-percent slope. The agricultural land in the coulees is considered adequately managed and offers little opportunity for improved management. Land treatment practices should be implemented wherever possible. However, without extensive use of earth dams or other retention measures, peak runoff flows could tend to increase as additional land is developed. Additional discussion of land resources management can be found on pages 11 through 14. Further consideration of earth dams is presented under plan 8, upstream reservoir storage.

#### STRUCTURAL ALTERNATIVES

##### Plan 8 - Upstream Reservoir Storage

A plan involving reservoir storage in State Road and Ebner Coulees required evaluation of a number of potential reservoir sites for State Road Coulee and for Ebner Coulee. The dry dam concept is used for this plan because existing runoff is insufficient to sustain a conservation pool. For State Road Coulee, a plan consisting of three reservoirs at tributary coulees was originally studied by the U.S. Soil Conservation Service during preauthorization studies. This plan has been updated to include current construction costs and current development conditions in the coulee. In addition, previous studies of two sites for larger reservoirs on State Road Coulee have been updated. Plate 4 shows the location of the reservoir sites that were evaluated in plan 8.

Based on current hydrologic studies and economic conditions, the three tributary reservoirs would reduce average annual flood damages by about \$1,520,000, or 70 percent of total average annual damages. The main stem reservoir site near the State Highway 33 bridge would reduce annual flood damages by about \$1,671,000, while a reservoir site farther downstream

(only one-half mile upstream of the Hagen Road bridge) would reduce average annual flood damages by about \$1,877,000. Since none of the reservoirs could individually control the 100-year frequency flood, a plan was evaluated using the reservoir site upstream of the Hagen Road bridge plus the three tributary reservoirs. Total estimated costs of this plan are about \$25.8 million, or \$1,904,000 in average annual costs. Average annual flood damages would be reduced by about \$2,136,000, or 98 percent of the total estimated annual flood damages. This plan would reduce the peak flow of the 100-year frequency flood by about 70 percent to 1,600 cfs (cubic feet per second) at the Hagen Road bridge.

For Ebner Coulee, two reservoir sites were evaluated. The upstream site, located about three-fourths of a mile upstream of the Burlington Northern railroad tracks would reduce average annual flood damages by about \$570,000 at a cost of about \$9.9 million. This site would involve the relocation of 26 residences. A reservoir site at the toe of the bluff adjacent to the railroad tracks would reduce flood damages by about \$650,000, at a cost of \$10.0 million, and involve the relocation of two residences and two commercial businesses. The downstream site would require fewer relocations, would not affect a natural wooded area, and would be more effective in reducing flood damages. Thus, the downstream site is considered the best plan involving reservoir storage and was used in subsequent evaluations of plan 8. The downstream reservoir site would control runoff from a 100-year frequency flood. However, only about 55 percent of the total drainage area contributing to the Ebner Coulee floodplain can be controlled by the reservoir.

The environmental impacts of reservoir storage in State Road Coulee would consist of the loss of some vegetation and trees with deposition of sediment in the reservoir storage areas. The reservoirs would significantly alter the aesthetic setting of the upper portion of State Road Coulee. The reservoir relocations would affect the limited amount of land available for residential development since 185 residences, State Highway 33, and other roads and utilities involving about 250 acres would require relocation. For Ebner Coulee the aesthetic setting of a reservoir

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immediately adjacent to developed residential areas is not considered attractive. The reservoir would require about 33 acres of land, which is significantly greater than alternative solutions involving channel modification. This would have an impact on the limited land available for future development.

#### Plan 9 - Levee and Floodway

This plan consists of a floodway system formed primarily by levees along both sides of State Road and Ebner Coulees. For State Road Coulee the total width of the floodway plus levees would vary from 200 to 260 feet (the narrower widths being at the upstream end). For Ebner Coulee, the total width of the floodway plus levees would vary from 160 to 200 feet. The alignment for State Road Coulee would follow the existing drainage course. The Ebner Coulee alignment would follow the authorized plan alignment consisting of a northward diversion to Miller Coulee and then extend along Miller Coulee to a marsh adjacent to the La Crosse River. Plate 4 shows the plan 9 alignment for both State Road and Ebner Coulees.

This plan would require replacement of several existing bridges with bridges at higher elevations requiring extensive ramping of the road approaches. Extensive riprapping of the riverward levee slopes would be required to prevent erosion during the occurrence of the design flood. For State Road Coulee, about 120 acres of land and relocation of 23 residences and one business would be required. For Ebner Coulee, about 44 acres of land and relocation of 38 residences and a golf course would be required. The total first costs of this plan are about \$41.4 million, with estimated first costs of \$24.3 million and \$17.1 million for State Road Coulee and Ebner Coulee, respectively. Total average annual flood damages would be reduced by 97 percent.

The environmental impacts of this plan include loss of 2 to 8 acres of floodplain habitat, temporary increases in turbidity, and a shifting of the sediment load in receiving waters until the channel is stabilized. There is potential for aggravation of trespass problems on the Upper Mississippi River Wild Life and Fish Refuge and possible impacts on endangered species habitat with this plan. While the number of residences requiring relocation is not excessive, other plans such as channel modification and flood proofing require fewer relocations. The aesthetic appearance of levees higher than those now existing would be considered unattractive by some homeowners living immediately adjacent to the levee.

#### Plan 10 - Channel Modification

Developing a flood control plan involving channel modification for State Road and Ebner Coulees required evaluation of various plans for reconstructing the channels along their present alignment. Based on hydrologic and economic studies, all modification plans would reduce the flood damages induced by the 100-year flood by about 99 percent for both State Road and Ebner Coulees. The various channel modification plans studied for State Road and Ebner Coulees include earth channels, riprap-lined channels, concrete-lined channels, concrete-lined channels plus inclosed conduits, and a concrete-lined/earth channel plan (subsequently changed to a concrete-lined/riprap channel plan). Investigations were made to determine which plan would provide the maximum overall economic and environmental benefits and would meet specific planning objectives for the La Crosse area.

Channel dimensions for plans 10a, b, c, d, and e are shown on the following two tables. Note that for plans 10a, b, c, and d, Ebner Coulee and State Road Coulee both flow south, with Ebner Coulee combining with State Road Coulee near Highland Street. For plan 10e, Ebner Coulee is diverted north to Myrick Marsh and the La Crosse River. Plan 10e for Ebner Coulee is identical to, and is displayed as, alternative 12.



Alternative flood damage reduction plans for State Road Coulee,  
channel dimension data

	Plan 10a	Plan 10b	Plan 10c	Plan 10d	Plan 10e
				Concrete-lined plus inclosed channels	Concrete-lined channels plus Ebner Coulee diversion
State Road Coulee reaches (widths and depths are in feet)	Earth-lined channels	Riprap-lined channels	Concrete-lined channels		
I. Hagen Rd. to Ward Ave.					
a. Bottom width	60	60	10	10	20
b. Side-slope	1:3	1:2	1:2	1:2	1:2
c. Depth	8.0	8.2	7.7	7.7	7.0
d. Top width	126	126	50	50	58
e. Total width(1)	151	151	75	75	83
II. Ward Ave. to Highland St.					
a. Bottom width	200	190	55	55	30
b. Side-slope	1:3	1:2	1:2	1:2	1:2
c. Depth	6.4	6.5	7.6	7.6	8.0
d. Top width	254	244	95	95	75
e. Total width(1)	279	269	120	120	100
III. Highland St. to Burlington RR bridge					
a. Bottom width	210	200	65	65	30
b. Side-slope	1:3	1:2	1:2	1:2	1:2
c. Depth	6	6.5	7.1	7.1	8.0
d. Top width	264	254	105	105	75
e. Total width(1)	289	279	130	130	100
IV. Burlington Northern RR bridge to Mississippi River(2)					
a. Bottom width	210	200	75	75	145
b. Side-slope	1:3	1:2	1:2	1:2	1:3
c. Depth	6.5	6.5	6.5	6.5	6.2
d. Top width	270	254	111	111	199
e. Total width(1)	295	279	136	136	224

- (1) Includes 25 feet of additional right-of-way for lands bordering the proposed channels necessary for construction and maintenance.
- (2) The dimensions shown in the table for plan 10d reflect the required trench excavation for installation of underground conduits from State Road Coulee just downstream of the Broadview Plaza Street bridge and west to the Mississippi River.

Alternative flood damage reduction plans for Ebner Coulee,  
channel dimension data

	Plan 10a	Plan 10b	Plan 10c	Plan 10d
Ebner Coulee reaches (widths and depths are in feet)	Earth- lined channels	Riprap- lined channels	Concrete- lined channels	Concrete- lined plus inclosed channels
I. Entrance Rd. to Burlington Northern tracks				
a. Bottom width	40	30	10	10
b. Side-slope	1:3	1:2	Vertical	Vertical
c. Depth	5.6	5.1	6.7	6.7
d. Top width	90	62	10	10
e. Total width(1)	115	87	35	35
II. Along Burlington Northern tracks south to Farnam St.				
a. Bottom width	75	60	24	45
b. Side-slope	1:3	1:2	Vertical	1:2
c. Depth	4.2	6.3	7.4	10
d. Top width	117	96	24	85
e. Total width(1)	142	121	49	110
III. Farnam St. to Ward Ave.				
a. Bottom width	75	75	28	60
b. Side-slope	1:3	1:2	Vertical	1:2
c. Depth	5.5	7.0	7.2	10
d. Top width	129	115	28	100
e. Total width(1)	154	140	53	125
IV. Ward Ave. to State Road Coulee				
a. Bottom width	45	55	28	60
b. Side-slope	1:3	1:2	Vertical	1:2
c. Depth	5.8	6.3	7.2	10
d. Top width	99	91	28	100
e. Total width(1)	114	116	53	125

(1) Includes 25 feet of additional right-of-way for lands bordering the proposed channels necessary for construction and maintenance.

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State Road Coulee would be enlarged from its confluence with the Mississippi River upstream to the Hagen Road bridge, a distance of about 13,470 feet. The table on page 43 summarizes the economic and environmental effects, both beneficial and adverse, for the various channel modification plans. As shown in the table, four of the five plans would have adverse impacts on the Mississippi River floodplain and on the Overhead archeological site (specific planning objectives f. and g.). The earth channel alternative is the least costly; however, this plan does not meet another specific planning objective of minimizing the lands and relocations required. Therefore, the concrete-lined channel (plan 10c) with an earth section outlet is the most acceptable channel modification alternative of the five plans (10a to 10e) for State Road Coulee. The earth channel would need to be from three to six times wider than the concrete channel throughout the length of State Road Coulee. Plan 10 location alignments for both State Road and Ebner Coulees are shown on plate 4.

Ebner Coulee would be enlarged along its present alignment from the Entrance Road bridge downstream about 15,700 feet to its junction with State Road Coulee for plan 10. The beneficial and adverse economic and environmental effects are summarized in the table on page 44. As shown in the table, the earth channel (plan 10a) is again the most economical channel modification. The plan using concrete-lined channels (plan 10c) is the least disruptive, both socially and environmentally, because of the narrower widths required and is therefore the most acceptable. All four plan 10 variations shown for Ebner Coulee would have adverse impacts. Evaluation of plan 12 (channel modification and diversion) for Ebner Coulee shows that plan 12 is economically less costly than either plan 10a (earth-lined channels) or plan 10c (concrete-lined channels) and would not have adverse impacts on the Overhead site or the Upper Mississippi River Wild Life and Fish Refuge.

Alternative channel modification plans for State Road Coulee,  
economic, environmental and social impacts (October 1980 prices)

	Plan 10a	Plan 10b	Plan 10c	Plan 10d	Plan 10e
State Road Coulee	Earth-lined channels	Riprap-lined channels	Concrete-lined channels	Concrete-lined channels plus inclosed conduits	Concrete-lined channels plus riprap-lined channels
<b>I. NATIONAL ECONOMIC DEVELOPMENT</b> (A through E in \$1,000)					
A. Total first cost	18,083	27,084	23,739	30,256	19,069
B. Total average annual cost	1,339	2,003	1,756	2,236	1,411
C. Total average annual benefits(1)	2,272	2,272	2,272	2,272	2,272
D. Net average annual benefits(1)	933	269	516	36	861
E. Remaining average annual flood damages	5	5	5	5	5
F. Benefit-cost ratio (interest rate = 7 3/8 percent)	1.70	1.13	1.29	1.02	1.61
<b>II. ENVIRONMENTAL QUALITY</b>					
A. Woodland gained or lost (+ acres)					
1. Urban area	-3	-3	-2	-2	-1
2. Uplands	0	0	0	0	0
3. Bottomlands	-4	-5	-2	0	-2
B. Herbaceous areas (+ acres)					
1. Parks	-6	-6	-2	0	-6
2. Lawns	-23	-27	-13	-13	-6
3. Pastures and cropland	-2	-2	0	0	-1
C. Wetlands gained or lost (+ acres)	-4	-3	-2	0	-4
D. Other environmental factors	-----All plans have generally the same adverse effect-----				
1. Effect on refuge on Mississippi River floodplain					
2. Effect on National Register site					
<b>III. PLAN EFFECTIVENESS IN MINIMIZING LANDS REQUIRED FOR PROJECT PURPOSE AND RELOCATIONS</b>					
	Not effective	Not effective	Effective	Effective	Effective
A. Lands required for project (acres)(2)	(50)	(49)	(3)	(3)	(8)
B. Residences requiring relocation	(45)	(44)	(0)	(0)	(0)

(1) Only direct flood damage reduction and transportation benefits are included.

Alternative channel modification plans for Ebner Coulee  
Economic, environmental and social impacts (October 1980 prices)

	Plan 10a	Plan 10b	Plan 10c	Plan 10d
Ebner Coulee	Earth-lined channels	Riprap-lined channels	Concrete-lined channels	Concrete-lined channels plus inclosed conduits
I. NATIONAL ECONOMIC DEVELOPMENT (A through E in \$1,000)				
A. Total first cost	16,509	20,322	17,135	26,634
B. Total average annual cost	1,220	1,502	1,267	1,968
C. Total average annual benefits(1)	1,004	1,004	1,004	1,004
D. Net average annual benefits(1)	-216	-498	-263	-964
E. Remaining average annual flood damages	10	10	10	10
F. Benefit-cost ratio (interest rate = 7 3/8 percent)	0.82	0.67	0.79	0.51
II. ENVIRONMENTAL QUALITY				
A. Herbaceous areas (+ acres)				
1. Parks	0	0	0	0
2. Lawns	-26	-24	-12	-19
3. Pastures and croplands	0	0	0	0
B. Other environmental factors	-----All plans have generally the same effect-----			
III. PLAN EFFECTIVENESS IN MINIMIZING LANDS REQUIRED FOR PROJECT PURPOSE AND RELOCATIONS	Not effective	Not effective	Effective	Effective
A. Lands required for project (acres)	(39)	(32)	(15)	(25)
B. Residences requiring relocation	(112)	(109)	(9)	(7)

(1) Only direct flood damage reduction and transportation benefits are included.

### Plan 10 Variations

Early in the formulation process the Minnesota Department of Natural Resources and the U.S. Fish and Wildlife Service expressed strong reservations concerning potential impacts of any State Road Coulee project on the Mississippi River floodplain and the Upper Mississippi River Wild Life and Fish Refuge. They were particularly opposed to any plan which would have adverse impacts on the floodplain habitat and the refuge. (See planning objective f. summarized earlier.)

All of the previous channel plans 10a to 10e for State Road Coulee would have adverse impacts on floodplain habitat and on the refuge and thus would not comply with planning objective f. (As stated earlier, plans 10a and 10b also did not meet the specific planning objective of minimizing lands required for project purposes and relocation.) Plan 10e for State Road Coulee (with concrete-lined channels) was the most economical remaining channel modification alternative and was evaluated further.

Seven possible variations involving the concrete channel alternative (plan 10e) were then considered and summarized for the lower end of State Road Coulee in the reach from the Mississippi River (station 0+00) to the Highway 14 and 61 bridge at station 20+00. These variations are described in the following figures, summaries, and tables. To simplify the description, the lower terminus variations are not considered alternative plans, but are shown as variations of the recommended channel modification plan (10e) for State Road Coulee.

# LEGEND:



CONCRETE CHANNEL

○ ○ ○ ○ ○ (E) EARTH LINED CHANNEL

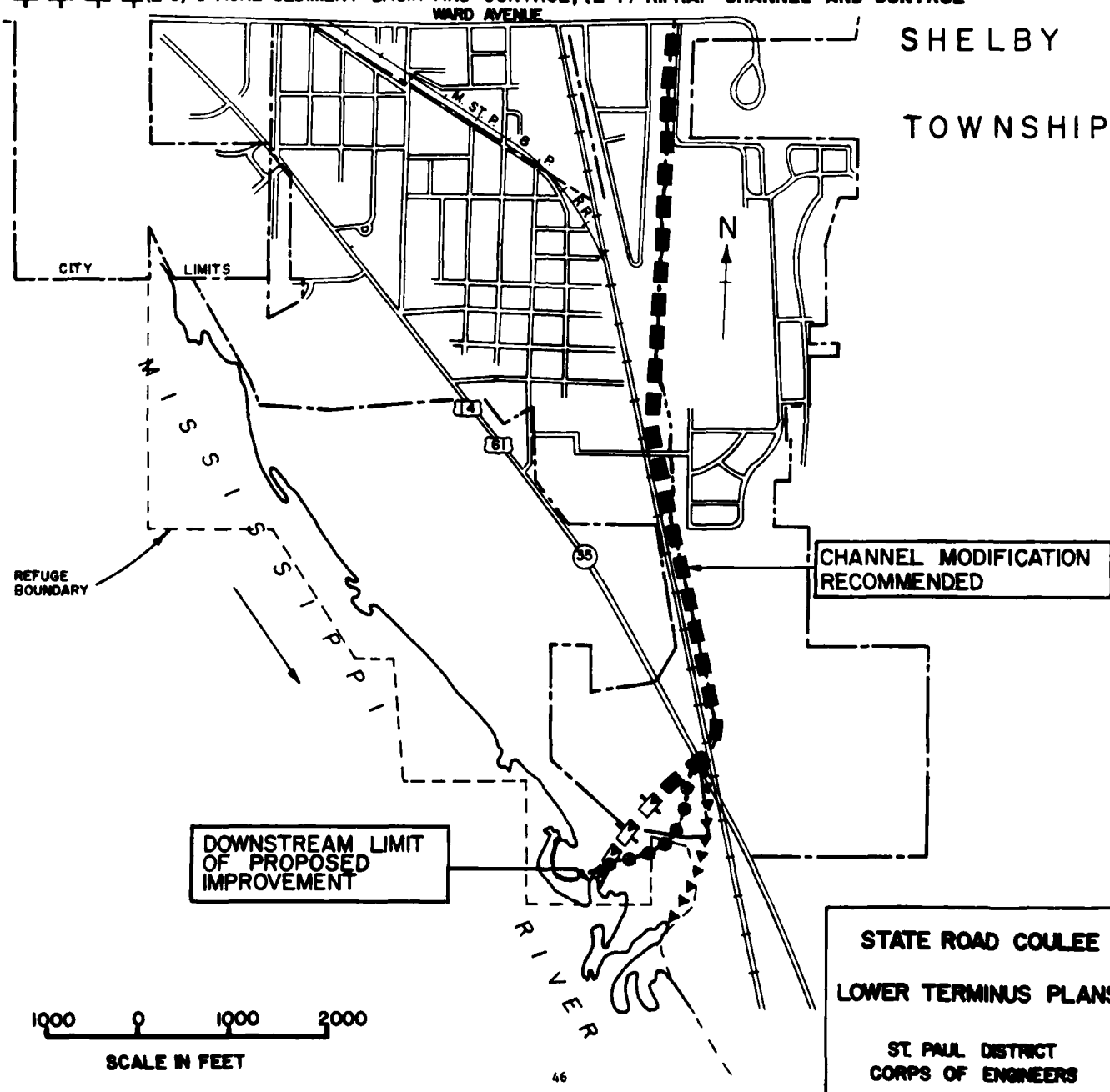
◄ ◄ ◄ ◄ ◄ (E-1) EARTH CHANNEL NORTHWEST OF EXISTING CHANNEL TO AVOID WOODED AREA

◄ ◄ ◄ ◄ ◄ (E-2) EARTH CHANNEL SOUTHEAST OF EXISTING CHANNEL TO AVOID WOODED AREA

◄ ◄ ◄ ◄ ◄ (E-3) EARTH PILOT CHANNEL FOLLOWING EXISTING ALIGNMENT

□ □ □ □ □ (E-5) NOV. 1976 PLAN: 80 FOOT TRAPEZOIDAL EARTH BOTTOM, TO 10 FOOT PILOT CHANNEL

⊞ ⊞ ⊞ ⊞ ⊞ (E-6) 5 ACRE SEDIMENT BASIN AND CONTROL, (E-7) RIPRAP CHANNEL AND CONTROL



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Eight lower channel modification plan variations, including the authorized plan from the 1967 survey report, are described below.

Authorized Plan (Contained in the 1967 Survey Report). - This plan consists of a 70-foot bottom rectangular flume through the railroad and Highway 61 bridges and a 175-foot riprap transition from about station 17+25 to station 15+50. Downstream of the transition is an earth channel with a 130-foot bottom width and 1:3 side slopes to station 0+00. The earth channel follows the existing channel alignment. The design  $Q = 5,100$  cfs for the 50-year design. This channel passes through the refuge boundary and extends 1,100 feet into the Mississippi River floodplain.

Design E. - The plan consists of an 80-foot rectangular bottom concrete flume through the railroad and Highway 61 bridges (to station 17+25), a 175-foot riprap transition as in the authorized plan, and a 145-foot bottom earth channel with 3:1 side slopes to station 0+00. The earth channel follows the existing channel alignment. The design  $Q = 6,230$  cfs for the 100-year design. This channel passes through the refuge boundary and extends 1,100 feet into the Mississippi River floodplain.

Design E-1. - An earth channel was sized to contain the design flow northwest of the existing channel. The alignment avoids wooded areas to the maximum extent practical. The channel is trapezoidal, with a bottom width of 185 feet and 3:1 side slopes. Levees on both sides of the channel are required to contain the design flow. Once floodwaters reach the downstream end of the design, the water will spread out over the marsh area of the Mississippi River bottomlands. Riprap has been provided at this location to minimize scour. Some levees will be required along this reach to contain design flows. No bridges or utility relocations are expected along the proposed alignment. The project will end at station 0+00. This channel avoids the refuge boundary but extends 900 feet into the Mississippi River floodplain.

Design E-2. - An earth channel was sized to contain the design flow southeast of the existing channel with its alignment avoiding wooded areas to the maximum extent practical. The earth channel is trapezoidal, with a 240-foot bottom width and 3:1 side slopes. Levees on both sides of the



channel are required to contain design discharges. Riprap has been provided at the downstream terminus for scour protection. All quantities were determined using existing topography in the area. Where data were not available, approximate elevations were estimated. No utility relocations or bridges are required along this alignment. This plan involves a 2,600-foot earth channel with separate terminus location. This channel avoids the refuge and the Mississippi River floodplain but adversely affects the National Register Overhead site (specific planning objective g.)

Design E-3. - An earth pilot channel was designed following the existing channel alignment with excess flows allowed to flow overbank. A levee was provided along the south side of the trees to protect cropland in that area. All development in the area is above approximate elevation 650. The excavated pilot channel from the upstream end to station 7+00 is trapezoidal with an 80-foot bottom width and 3:1 side slopes. Beyond station 7+00 the pilot channel has a 10-foot bottom. Very few trees will be removed in this design. The end of project is at station 0+00. This channel passes through the refuge boundary and extends 1,200 feet into the Mississippi River floodplain.

Design E-4. - Design E-4 was an Ebner Coulee design.

Design E-5 (Recommended Plan in the 1976 Draft GDM). - This plan consists of an 80-foot rectangular bottom flume through the railroad and Highway 61 bridges and a 175-foot riprap transition as in the authorized plan. An 80-foot bottom, 3:1 side slope, earth trapezoidal channel from about station 15+00 would extend downstream about 600 feet to the Mississippi River floodplain. From there, an earth pilot channel with 10-foot bottom and 3:1 side slopes would extend 700 feet into the Mississippi River floodplain, ending at station 2+00. The alignment of the plan would go north of the existing channel in the same manner as alternative E-1, thus cutting off about 200 feet of stationing along the old channel center line. The design  $Q = 6,230$  cfs. This channel avoids the refuge boundary, but extends 700 feet into the Mississippi River floodplain.

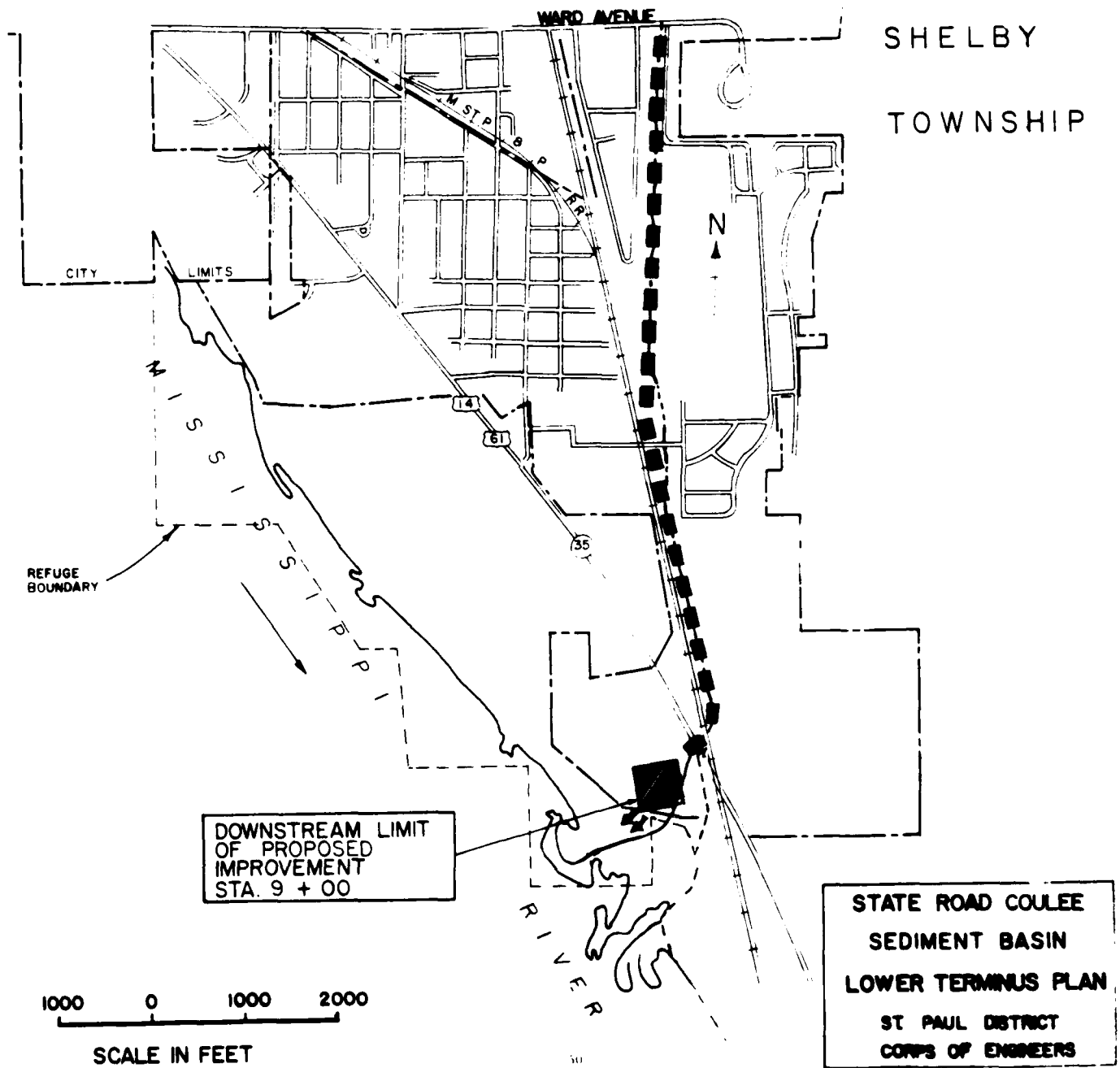
27

Design E-6 (Proposed by the Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service, April 1980). - This plan consists of an 80-foot rectangular flume through the railroad and Highway 61 bridges, a 150-foot riprap transition from station 17+00 to station 15+50, a 4.8 acre sediment basin from station 15+50 to station 10+50, and a 238-foot wide crest riprap outlet control from station 10+00 to station 9+00 (end of project). The U.S. Fish and Wildlife Service originally proposed such a basin upstream of the Burlington Northern railroad tracks, but the upstream location would cost approximately \$1 million more than the E-6 location and might not be as effective. Thus, the lower location is included in these comparisons. This channel would not enter the Mississippi River floodplain or the refuge.

The idea behind the impoundment proposal is that the basin could trap sediment, thereby reducing impacts on downstream water quality. The basin could develop wetland habitat by means of water impoundment and subsequent establishment of aquatic plants. The location of the sediment basin is shown on the following figure.

# LEGEND:

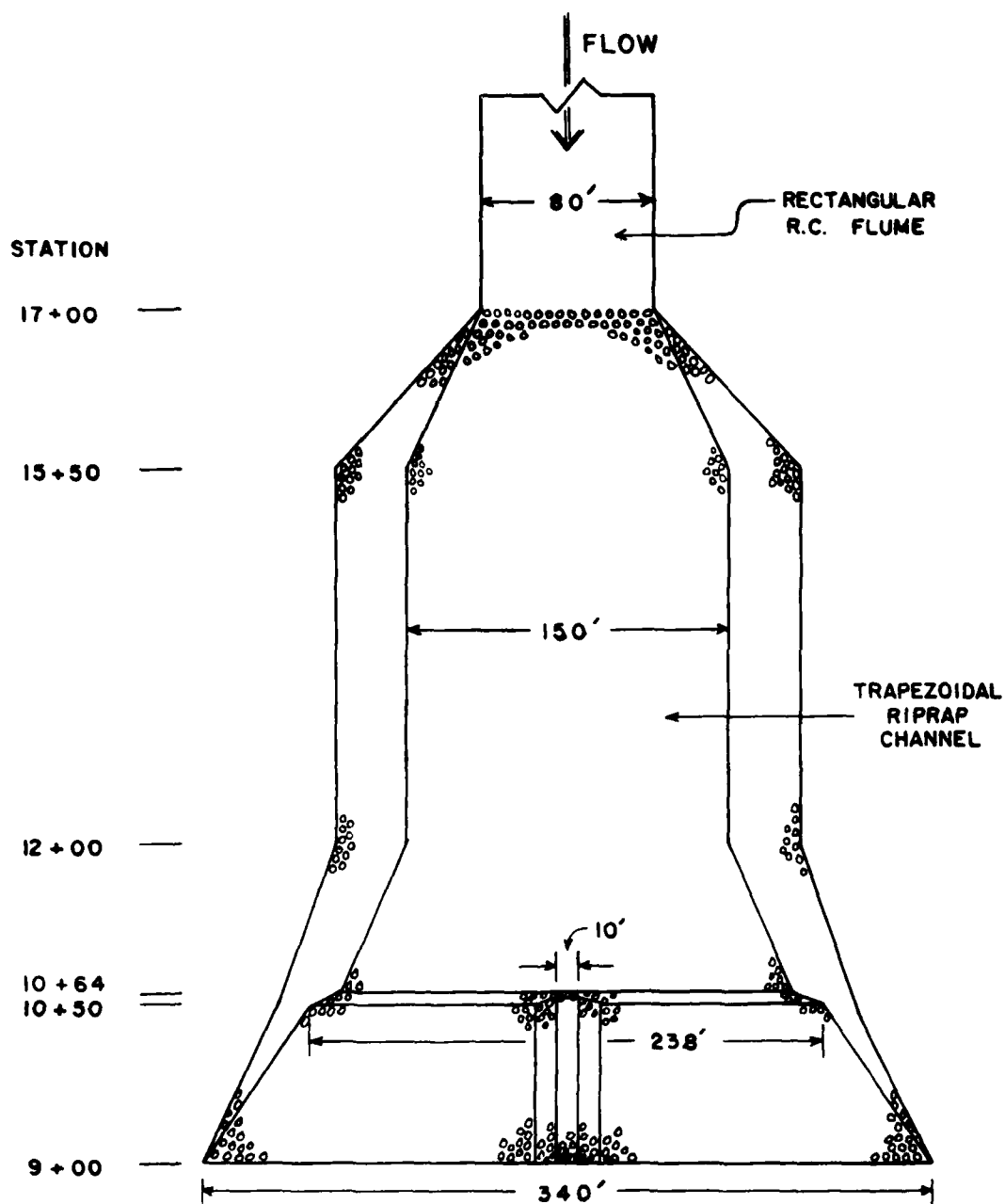
■■■■ CONCRETE CHANNEL WITH 5 ACRE ± SEDIMENT BASIN



27

Design E-7. - This plan consists of an 80-foot rectangular flume through the railroad and Highway 61 bridges, a 150-foot riprap transition from about station 17+00 to station 15+50, a trapezoidal riprap channel with 3:1 side slopes and a 150-foot bottom width from station 15+50 to station 10+50, a 238-foot wide crest outlet control at station 10+50, and a riprap outlet control from station 10+50 to 9+00 (end of project). Although the channel terminates before entering the refuge, the outlet structure necessary for dispersing design flows would extend from 100 to 150 feet into the Mississippi River floodplain.

Both plans E-6 and E-7 would include a riprap outlet control from about station 15+50. This outlet control would include a 10-foot bottom width low water channel at elevation 633.5, with 1:3 side slopes. Higher flows would flow over a fan-shaped weir at elevation 636.5. The weir width would enlarge from 238 feet at station 10+50 to 340 feet at station 9+00 (see the following sketch). These two plans are the only lower variations that comply with the specific planning objective f. and are considered further in the analysis.



STATE ROAD COULEE  
LOWER TERMINUS PLAN

The following table compares the overall channel modification effects for each of the lower channel variations.

Alternative channel modification plans for State Road Coulee, economic, environmental and social impacts  
(October 1980 prices)

State Road Coulee	Plan 10e variations (railroad to Mississippi River)						
	E	E-1	E-2	E-3	E-5	E-6	E-7
	Existing channel alignment (earth)	North of existing channel (earth)	South of existing channel (earth)	Existing channel (earth pilot)	North of existing channel (earth pilot)	Sediment basin no floodplain channel	Weir control no flood- plain channel
<b>I. NATIONAL ECONOMIC DEVELOPMENT</b> (A through E in \$1,000)							
A. Total first cost	19,069	19,270	19,535	18,945	19,176	20,204	19,851
B. Total average annual cost	1,411	1,426	1,446	1,402	1,419	1,495	1,469
C. Total average annual benefits <sup>(1)</sup>	2,272	2,272	2,272	2,272	2,272	2,272	2,272
D. Net average annual benefits <sup>(1)</sup>	861	46	826	870	853	777	803
E. Remaining average annual flood damages	5	5	5	5	5	5	5
F. Benefit-cost ratio (interest rate - 7 3/8 percent)	1.61	1.59	1.57	1.62	1.60	1.52	1.55
<b>II. ENVIRONMENTAL QUALITY</b>							
A. Woodland gained or lost (± acres)							
1. Urban area	-1	0	-1	-1	0	0	0
2. Uplands	0	0	0	0	0	0	0
3. Bottomlands	-2	-2	-2	-2	-1	-1	-1
B. Herbaceous areas (± acres)							
1. Parks	-6	-6	-6	-6	-6	-6	-6
2. Lawns	-6	-6	-6	-6	-6	-6	-6
3. Pastures and cropland	-1	-1	-3	-1	-1	-5	-5
C. Wetlands gained or lost (± acres)	-4	-2	-1	-2	-2	-1	-1
D. Other environmental factors							
1. Effect on refuge or Mississippi River floodplain	Adverse	Adverse	None	Adverse	Adverse	Minimal	Minimal
2. Effect on National Register site	Adverse	None	Adverse	Adverse	None	None	None
<b>III. PLAN EFFECTIVENESS IN MINIMIZING LANDS REQUIRED FOR PROJECT PURPOSE AND RELOCATIONS</b>							
A. Lands required for project (acres)	(8)	(7)	(9)	(3)	(4)	(7)	(7)
B. Residences requiring relocation	(0)	(0)	(1)	(0)	(0)	(0)	(0)

(1). Only direct flood damage reduction and transportation benefits are included.

### Summary

The following table summarizes the estimated costs of the seven design variations for the channel modification plan (plan 10).

Design	Cost comparison	
	Construction cost	Total project cost
Authorized plan	(2)	(2)
E	\$235,500	\$19,068,800
E-1	436,600	19,269,900
E-2	702,000	19,535,300
E-3	111,300	18,944,600
E-5	342,600	19,175,900
E-6	1,371,000	20,204,300
E-7	1,017,700	19,851,000

(1) Includes no costs for engineering or contingencies.

(2) The channel in the authorized plan was designed for the 2-percent chance (50-year) flood. Therefore, this plan does not meet current design criteria and its costs are not comparable with those of the other designs.

• The authorized plan channel would enter the Mississippi River and end at the boundary of the Upper Mississippi River Wild Life and Fish Refuge. The location of this channel is environmentally unacceptable, and the Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service oppose this alternative. Also, this channel, which was designed for the 2-percent chance (50-year) flood, does not meet current Corps design criteria.

• Designs E and E-3, although less costly than other designs, follow the existing natural channel alignment and are less acceptable to the Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service. These two designs would also have impacts on the identified



National Register archeological site and are not acceptable under any circumstances. Both E and E-3 channels would enter the Mississippi River floodplain, ending at station 0+00, and cross a portion of the Upper Mississippi River Wild Life and Fish Refuge.

- The E-1 channel must, by design, traverse into the Mississippi River floodplain to function properly. This alternative would require more land area and is not acceptable for environmental reasons similar to those associated with designs E and E-3.

- Design E-2 would have even more impacts on the National Register archeological site than designs E and E-3 and is therefore unacceptable.

- Design E-5 was an attempt at an early compromise to reduce the environmental effects of constructing a channel into the Mississippi River floodplain. However, both the Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service oppose intrusion onto the floodplain area if it can be prevented. Detrimental effects on the environment and increased trespass problems with the Upper Mississippi River Wild Life and Fish Refuge are primary concerns.

- Design E-6 was an alternate design developed from suggestions by the Fish and Wildlife Service and the Wisconsin Department of Natural Resources. This design would be most costly and would require 4.8 acres of open space. Potential problems associated with plan 10e-6 are the availability of adequate inflow throughout the year to maintain the area as a wetland cover type, the possible establishment of undesirable or low value vegetation, the deposition of unsuitable soil types, the possible entrapment of fish behind the sediment basin on that control, and the questionable ability of a wetland ecosystem in the basin to recover after flood events. In addition, necessary maintenance activities could negate any possible habitat benefits of the design.

- Design E-7 requires less land than E-6, is less costly than E-6, and is considered the least environmentally damaging by the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources. Also, local interests favor this alternative over design E-6. Both 10e-6 and 10e-7 are included in the tabular summaries on pages 66 and 71. The riprap channel alignment for E-7 is shown on the following photograph.



## Plan 11 - Reservoir Plus Channel Modification

This plan would consist of the reservoirs as described in plan 8 and additional channel modifications sized to prevent flooding from the 100-year frequency flood condition. The reservoirs and channel alignment for plan 11 are identical to those of a combination of plans 8 and 10, which was previously identified and shown on plate 4. The reservoirs for State Road Coulee would reduce the peak flow of the 100-year frequency flood by about 60 percent. Channel modifications would then be sized to prevent flooding from a peak flow of 1,600 cfs at the Hagen Road bridge. This compares with a peak flow of 5,340 cfs without the reservoirs in place. The reservoir for Ebner Coulee would reduce the peak flow of the 100-year frequency flood by about 55 percent. Channel modifications would then be sized to contain a peak flow of about 650 cfs at the upstream end of the channel works. The channel would extend south adjacent to the Burlington Northern railroad tracks and join with State Road Coulee. This peak flow compares with a peak flow of 1,490 cfs without the reservoir in place.

The first costs of this plan would be about \$36.4 million for State Road Coulee and about \$15.3 million for Ebner Coulee. Average annual flood damages would be reduced by about 99 percent. The relocations required for State Road Coulee include 185 residences in the reservoir area. Relocation of State Highway 33 would also be required along with relocation of various utilities. The relocations required for Ebner Coulee include two residences and two businesses in the reservoir area and five residences along the channel modification works. Relocation of Cass Street would also be required along with relocation of various utilities.

The major effect of this plan is similar to the reservoir only plan in that attractive residential areas would be relocated and environmental impacts would be more significant than with channel modification alone.

### Plan 12 - Channel Modification and Diversion

This plan would consist of channel modification plus diversion channels at appropriate locations to convey State Road and Ebner Coulee flood flows by a more direct route to larger receiving streams. A combination of concrete-lined open channels and inclosed concrete conduits was used to estimate costs. The plan for State Road Coulee would be to modify the existing channel from Hagen Road bridge to about 300 feet south of the Broadview Place bridge and then provide an underground diversion conduit extending southwest to the Mississippi River. The plan for Ebner Coulee would be to modify the existing channel from the upstream end of the study area to the Burlington Northern railroad tracks, provide diversion works northward to Miller Coulee, and then to a marsh adjoining the La Crosse River. Plate 4 shows the channel modification and diversion alignment for plan 12 for both State Road and Ebner Coulees.

Construction dimension data for plan 12 for State Road Coulee and Ebner Coulee are shown on the following two tables. These dimensional data can be compared with similar data presented for plans 10a, b, c, d, and e for State Road Coulee and for plans 10a, b, c, and d for Ebner Coulee.

Channel Dimension Data - Plan 12

		<u>Plan 12</u>
		Concrete-lined channels plus State Road diversion
<u>STATE ROAD COULEE REACHES</u> (widths and depths are in feet)		
I.	Hagen Road to Ward Ave.	
a.	Bottom width	18
b.	Side-slope	1:2
c.	Depth	7.0
d.	Top width	58
e.	Total width(1)	83
II.	Ward Ave. to Highland St.	
a.	Bottom width	30
b.	Side-slope	1:2
c.	Depth	8.0
d.	Top width	75
e.	Total width(1)	100
III.	Highland St. to Burlington Northern RR Bridge	
a.	Bottom width	30
b.	Side-slope	1:2
c.	Depth	8.0
d.	Top width	75
e.	Total width(1)	100
IV.	Burlington Northern RR Bridge to Mississippi River(2)	
a.	Bottom width	55
b.	Side-slope	-
c.	Depth	8.0
d.	Top width	55
e.	Total width(1)	80

- (1) Includes 25 feet of additional right-of-way for lands bordering the proposed channels necessary for construction and maintenance.
- (2) The dimensions shown in the table for plan 12 reflect the required trench excavation for installation of underground conduits from State Road Coulee just downstream of the Broadview Plaza Street bridge and west to the Mississippi River.

Channel Dimension Data - Plan 12 (cont.)

		Plan 12
		Concrete-lined channels plus Ebner Coulee diversion
EBNER COULEE REACHES (widths and depths are in feet)		
I. Entrance Rd. to Burlington Northern tracks		
a. Bottom width		16
b. Side-slope		Vertical
c. Depth		5.0
d. Top width		16
e. Total width(1)		41
II. Along Burlington North tracks to Miller Coulee(2)		
a. Bottom width		30
b. Side-slope		1:2
c. Depth		10
d. Top width		70
e. Total width(1)		95
III. Miller Coulee Junction to U.S. Highway 16		
a. Bottom width		30
b. Side-slope		1:4
c. Depth		5
d. Top width		94
e. Total width(1)		119
IV. U.S. Highway 16 to La Crosse River Marsh		
a. Bottom width		30
b. Side-slope		Vertical
c. Depth		5.5
d. Top width		30
e. Total width(1)		55
(1) Includes 25 feet of additional right-of-way for lands bordering the proposed channels necessary for construction and maintenance.		
(2) This reach consists of two underground conduits, 154 by 97 inches. The dimensions shown in the table reflect the required trench excavation to install these conduits.		

For State Road Coulee, approximately 8,400 feet of trapezoidal concrete-lined channel would extend along the existing alignment. The first 1,000 feet of diversion works would use a 55-foot-wide rectangular concrete-lined channel, and the remaining 2,000 feet to the Mississippi River would use five 7- by 11-foot box conduits about 40 feet underground. The estimated first costs are \$22.7 million, resulting in an average annual cost of \$1,679,000. The plan effects are summarized on pages 66-71. The biological and human environment impacts would be similar to those of the channel modification plan (plan 10 variations).

For Ebner Coulee, about 1,500 feet of rectangular concrete-lined channel would extend along the existing alignment to the Burlington Northern railroad tracks. From this point the diversion works would utilize underground conduit for about 4,800 feet to Miller Coulee to minimize the relocations of residences and a public golf course. The La Crosse Country Club golf course would not be relocated with this alternative, and only two residential units are likely to require removal (a fourplex on Cass Street and a garage between Cass and Main Streets). The existing alignment of Miller Coulee would be enlarged with earth and concrete channels for about 1,400 feet to its downstream terminus at a marsh in the La Crosse River floodplain.

The estimated first costs are about \$11.7 million or average annual costs of \$869,000. Flood damages would be reduced by about 70 percent. The environmental impacts of this plan would be more beneficial than those associated with channel modification along the existing alignment in that the La Crosse River marsh area at the downstream terminus of the diversion works would receive runoff from Ebner Coulee which now flows into the Mississippi River from a 72-inch storm sewer located on the lower end of State Road Coulee.

An earth channel along the above diversion alignment was also evaluated. The earth channel would start at Main Street (station 44+00) and proceed to just upstream of the Chicago, Burlington and Quincy Railroad bridge on Miller Coulee (station 16+65). Other features of this alternative would be identical to those previously described in alternative 12 and shown on plate 7-2 for Ebner Coulee.

This plan would also require relocation of two residential units (one fourplex on Cass Street and one single unit on Main Street).

The plan would also require relocation of the golf course to an undetermined location, probably miles away. At 110 acres, the golf course is already well under the 190 acres normally considered necessary for an 18-hole course, and it could not be rearranged to accommodate the loss of 14 acres that this plan would require. The estimated first cost of this alternative is \$11.9 million, slightly more than the cost of the enclosed conduit plan previously described.

#### SUMMARY EVALUATION OF PLANS

The following tables summarize the economic and environmental impacts of the proposed State Road and Ebner Coulee alternatives.



Alternative flood damage reduction plans for State Road Coulee, Wisconsin, economic and environmental impacts

State Road Coulee	No action	Early emergency warning system	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10e-6	Plan 10e-7	Plan 11	Plan 12	Channel modification and diversion
Alternative flood damage reduction plans for State Road Coulee, wicacousin, economic and environmental impacts																
Channel modification																
Perma- nent levees																
Storage reservoirs																
Land treat- ment																
Combini- tion of plans 2, 3, 5																
Floodplain regulation																
Flood insur- ance																
Total evacuation																
Flood proofing																
Total evacuation																
Early emergency warning system																
No action																
Plan 1																
Plan 2																
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NOTE: All plans relate to the 1-percent chance (100-year) flood event.

Alternative flood damage reduction plans for State Road Coulees, Wisconsin, economic and environmental impacts (cont.)

State Road Coulees	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10-6	Plan 11	Plan 12
	Early warning action system	Total evacuation	Flood proofing	Flood insurance	Floodplain regulation	Combina- tion of plans 2, 3, 5	Land treat- ment	Storage reservoirs	Perma- nent lawes	Channel modification with sediment basin	Combina- tion of plans 8, 10	Channel modifi- cation and diversion
A. Woodland gained or lost (± acres)	0	+10	0	0	0	+4	0	-9	0	0	-9	-10
1. Urban area	0	-30	0	0	0	-12	0	-23	0	0	-23	0
2. Uplands	0	0	0	0	0	0	0	0	-4	-1	-1	-2
3. Bottomlands	0	0	0	0	0	0	0	0	0	0	0	0
B. Barbecue areas (± acres)	0	+72	0	0	0	+31	0	+21	-10	-6	+21	-4
1. Parks and public lands	0	+35	0	0	0	+15	0	0	-32	-6	-2	-12
2. Lawns	0	-54	0	0	0	-27	0	-11	-2	-5	-11	0
3. Pastures and croplands	0	0	0	0	0	0	0	0	-5	-1	-2	-2
C. Wetlands gained or lost (± acres)	0	0	0	0	0	0	0	0	-5	-1	-2	-2
D. Streams affected	0	0	0	0	0	0	0	0	0	0	0	0
1. Continuously flowing streams.	0	0	0	0	0	0	0	0	0	0	0	0
Existing channelized	0	0	0	0	0	0	0	0	0	0	0	0
a. Channel affected (miles)	0	0	0	0	0	0	0	0	0	0	0	0
b. Channel bottom gained or lost (± acres)	0	0	0	0	0	0	0	0	0	0	0	0
2. Intermittent flow drainage	0	0	0	0	0	0	0	0	0	0	0	0
courses - existing natural	0	0	0	0	0	0	0	0	0	0	0	0
drainage/courses	0	0	0	0	0	0	0	0	0	0	0	0
a. Drainage courses gained or lost (± miles)	0	0	0	0	0	0	0	0	0	0	0	0
b. Percent of total drainage courses affected	0	0	0	0	0	0	0	0	0	0	0	0
3. Effect on stream erosion and sedimentation	None	None	None	None	None	None	None	Minor decrease	Minor decrease	Moderate decrease	Moderate decrease	Moderate decrease
4. Effect on stream water quality	None	None	None	None	None	None	None	None	None	None	None	None
5. Effect on stream water temperature	None	None	None	None	None	None	None	Minor increase	Minor increase	Minor increase	Minor increase	Minor increase
E. Effect on water table	None	None	None	None	None	None	None	None	None	Minor (lower)	Minor (lower)	Minor (lower)
F. Effect on scenic, recreation, or wilderness areas	None	Moderate	None	None	None	Minor	None	Moderate	Minor	Minor	Moderate	Minor
G. Riparian corridors lost or gained	None	Potential gain	None	None	None	Slight gain	Slight gain	Moderate loss	Slight gain	Minor	Moderate loss	None
H. Wildlife management area and refugees lost or gained	None	Potential gain	None	None	None	Slight gain	Slight gain	Moderate loss	Slight gain	Minor	Moderate loss	None
I. Effect on air quality	None	None	None	None	None	None	None	None	None	None	None	None
J. Rare, endangered, or threatened animal species affected	None	None	None	None	None	None	None	None	None	None	None	None
K. Rare or unique vegetation systems affected	None	None	None	None	None	None	None	None	None	None	None	None
L. Historical and/or archaeological sites affected	None	Unknown	Potential minor loss	None	None	Unknown	Unknown	Unknown	None	Potential minor loss	Potential minor loss	Potential minor loss
M. Effect on cultural centers	None	None	None	None	None	None	None	None	None	None	None	None

(1) Potential loss of 50-square-meter site north of Panel Creek and west of Highway 14 & 61. Overhead site not affected.

Plan 15 - Plan 10

[illegible]

(1) Average annual costs and benefits were computed using an interest rate of 7 7/8 percent.

(2) Residences required by levees and by underground diversion, respectively.

(13) Weir outlet control for E-6, and sediment basin outlet control for E-7.

(4) For structural alternative plans, the area remaining in the floodplain includes that required to convey the design flood flow including any reservoir storage areas.

(5) The figures include protection of 189 residential units from interrupted access and damage to surrounding grounds, while direct structural flood damage reduction involves 786 residences protected from interruption of access to surrounding areas.

(6) The lands proposed are in addition to those currently utilized by the existing channels and levees. (100)

Alternative flood damage reduction plans for Ebner Coulee, Wisconsin, economic and environmental impacts

Alternative flood damage reduction plans for Ebner Coulee, Wisconsin, economic and environmental impacts													
	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10c	Plan 11	Plan 12	
Ebner Coulee	No action	Early emergency warning system	Total evacuation	Flood proofing	Flood insurance	Floodplain regulation	Combination of plans 2, 3, 5	Land treatment	Storage reservoirs	Permanent levees	Channel modification of plans 8, 10	Channel modification and diversification	
I. NATIONAL ECONOMIC DEVELOPMENT (1) (A through F in \$1,000)													
A. Total first cost	0	?	36,398	17,450	?	?	15,880	?	10,017	17,145	17,135	15,340	11,746
1. Federal first cost	0	?	26,579	12,750	?	?	11,604	?	6,790	14,597	11,210	11,210	10,410
2. Non-Federal first cost	0	?	9,801	4,700	?	?	4,276	?	3,227	10,053	2,538	4,130	1,336
B. Total annual O&M cost	0	?	1	2	12	30	2	20	3	4	2	2	2
1. Federal	0	?	0	0	0	0	0	0	0	0	0	0	0
2. Non-Federal	0	?	1	2	12	30	2	20	3	4	2	2	2
C. Total average annual cost	0	?	2,688	1,290	245	?	1,174	?	742	1,265	1,267	1,134	869
1. Federal	0	?	1,963	940	175	?	856	?	501	519	1,077	827	759
2. Non-Federal	0	?	725	350	70	0	318	?	241	746	190	307	110
D. Total average annual flood control benefits	0	8	944	910	233	?	787	Minor	650	832	1,004	1,004	832
1. Flood damage reduction	0	8	932	898	0	?	787	Minor	633	942	961	961	789
2. Transportation	0	0	0	0	0	0	0	0	17	15	15	15	26
E. Net average annual benefits	0	?	1,744	-380	0	?	-387	?	-92	-280	-263	-130	-37
F. Remaining average annual flood damages	0	?	70	104	1,014	1,014	227		364	182	10	10	182
G. Benefit-cost ratio	0	?	.35	.71	.95	?	.67	?	.88	.66	.79	.89	.96

NOTE: All plans relate to the 1-percent chance (100-year) flood event.

Alternative flood damage reduction plans for Ebner Coulee, Wisconsin, economic and environmental impacts (cont)

	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10	Plan 11	Plan 12
	Early emergency action	Total evacuation	Flood proofing	Flood insurance	Floodplain regulation	Combination of plans 2, 3, 5	Land treatment	Storage reservoir with included conduit	Farmstead levee	Channel modification	Combination of plans 8, 10	Channel modification and diversion
<b>II. ENVIRONMENTAL QUALITY</b>												
<b>A. Wetland gained or lost (<math>\pm</math> acres)</b>												
1. Urban area	0	+9.4	0	0	0	+1.3	0	0	-2.0	0	0	-1.0
2. Uplands	0	-17.7	0	0	0	0	0	0	0	0	0	0
3. Bottomlands	0	0	0	0	0	0	0	-0.3	-0.3	0	0	-0.3
<b>B. Barren area (<math>\pm</math> acres)</b>												
1. Parks and public lands	0	+5	0	0	0	0	0	0	0	0	0	-5.0
2. Farms	0	+56	0	0	0	+9	0	-5.1	-43.9	-12	-15	-2.3
3. Other	0	-71	0	0	0	-13	0	-28.2	0	0	-28.2	-0.5
<b>C. Wetlands gained or lost (<math>\pm</math> acres)</b>												
1. Wetlands	0	0	0	0	0	0	0	-0.4	-1.3	0	0	-0.4
<b>D. Streams affected</b>												
1. Intermittent flow drainage courses, existing channelized												
a. Drainage course affected	0	0	0	0	0	0	0	0.7	0.7	1.7	1.7	0.7
b. Percent of total drainage course affected	0	0	0	0	0	0	0	30	30	100	100	30
2. Effect on stream erosion and sedimentation	None	None	None	None	None	None	None	Minor decrease	Minor decrease	Major decrease	Major decrease	Major decrease
3. Sedimentation of channels or drains requiring maintenance	None	None	None	None	None	None	None	None	None	None	None	None
4. Effect on stream water quality	None	None	None	None	None	None	None	None	None	None	None	None
5. Effect on stream water temperatures	None	None	None	None	None	None	None	Minor increase	None	Minor increase	Minor increase	None
<b>E. Effect on water table</b>	None	None	None	None	None	None	None	None	None	Minor (lower)	None	Minor (lower)
<b>F. Effect on scenic, recreation, or wilderness areas</b>	None	Moderate Potential gain	None	None	None	Minor	None	Minor	Minor	Minor	Minor	Minor
<b>G. Riparian corridors lost or gained</b>	None	None	None	None	None	Slight gain	None	None	Slight gain	None	None	None
<b>H. Wildlife management uses and refuges lost or gained</b>	None	None	None	None	None	None	None	None	None	None	None	None
<b>I. Effect on air quality</b>	None	None	None	None	None	None	None	None	None	None	None	None
<b>J. Rare, endangered, or threatened animal species affected</b>	None	None	None	None	None	None	None	None	None	None	None	None
<b>K. Rare or unique vegetation systems affected</b>	None	None	None	None	None	None	None	None	None	None	None	None
<b>L. Historical and/or archeological sites affected</b>	None	None	None	None	None	None	None	None	None	None	None	None
<b>M. Effect on cultural centers</b>	None	None	None	None	None	None	None	None	None	None	None	None

None in area

None

None

None known in area

Unknown

No centers in affected area



## PLAN FORMULATION

### GENERAL

In selecting a plan it is necessary to determine from the numerous alternatives several plans which best serve the range of established planning objectives. These plans will serve as a basis for further deliberation in selecting the best overall plan. As a minimum, the Principles and Standards require that a national economic development (NED) plan and an environmental quality (EQ) plan be identified. All other plans selected for further consideration will be examined to identify those that provide a mix of NED and EQ benefits and may constitute the best overall plan.

### ALTERNATIVE PLANS CONSIDERED FURTHER

The alternative plans considered further were selected on the basis of each plan's ability to satisfy the specific planning objectives. The objective of providing significant flood damage reduction for which the original study and project plan were authorized is considered the most significant objective.

### STATE ROAD COULEE ALTERNATIVES

The following table summarizes the effects of various alternative plans on the specific planning objectives.

State Road Coulee - effects of alternative plans on specific planning objectives

	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10-6	Plan 10-7	Plan 11	Plan 12
	Early emergency warning system	Total evacuation	Flood proofing	Flood insurance	Floodplain regulation	Combination of plans 2, 3, 5	Land treatment	Storage reservoirs	Permanent levees	Channel modification with sediment basin control	Channel modifications w/weir control	Combination of plans 8, 10	Channel modification
Specific planning objectives	No action	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
a. Significant flood damage reduction or compensation (percent reduction in average annual damages)	No (0)	Yes (97)	Yes (89)	Yes (0)	No ?	Yes (89)	No ?	Yes (97)	Yes (99)	Yes (99)	Yes (99)	Yes (99)	Yes (99)
b. Minimize lands and relocations required (land required, acres) (residences relocated)	Yes (0)	No (266) (397)	Yes (0)	Yes (0)	Yes (0)	No (68) (165)	Yes ?	No (256) (185)	No (124) (23)	Yes (16) (0)	Yes (6) (0)	No (278) (185)	Yes (16) (23)
c. Preserve or enhance area aesthetics	Yes	Yes	No	Yes	Yes	Partially disruptive	Yes	Partially disruptive	Partially disruptive	Partially disruptive	Partially disruptive	Partially disruptive	Partially disruptive
d. Compatible with overall land use planning for the La Crosse area	No	No	Yes	Yes	Yes	Yes	Yes	No	Moderately compatible	Yes	Yes	No	Yes
e. Minimize safety hazards associated with steep watersheds	No	Major reduction	Major reduction	No	No	Moderate reduction	No	Major reduction	Major reduction	Major reduction	Major reduction	Major reduction	Major reduction
f. Minimize adverse impacts on fish and wildlife habitat including effects on Upper Mississippi River Wild Life and Fish Refuge	Yes	Habitat losses for relocations	Yes	Yes	Yes	Habitat losses for relocations	Yes	Habitat losses for relocations	No	Yes	Yes	Habitat losses for relocations	Yes
g. Avoid or minimize impacts on Overhead archeological site	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes



Based on these objectives, the following alternative plans for State Road Coulee were omitted from further consideration.

- No Action. - The no action plan describes current conditions. The plan offers no relief from potential flood damages to floodplain properties or from the safety hazards associated with rapid runoff from the steeply sloped upper portion of the coulee. In addition, current State law requires the adoption of floodplain regulations by the county and local governments.

- Early Emergency Warning System (Plan 1). - Sufficient advance warning time cannot be relied upon in areas subject to flash flooding. General alerts of potentially severe rainfall would not be sufficient to prevent significant property damage and safety hazards associated with rapid runoff.

- Total Evacuation (Plan 2). - This plan is not compatible with the overall land use planning for the La Crosse area since existing vacant developable land within the La Crosse area is not sufficient to meet anticipated land needs by the year 1990. Thus, land now developed for urban use is valuable and efforts to reduce flood damages on the land would be more compatible with current land use planning and would minimize the need to develop other land for urban use.

- Land Treatment (Plan 7). - This plan cannot provide any major reductions in existing flood damages or significantly reduce the safety hazard associated with potential flash flooding from intense rainfall.

- Storage Reservoirs (Plan 8). - This plan provides a significant degree of flood damage reduction but is not compatible with the overall land use planning for the La Crosse area. In addition, this

plan requires considerable land area and relocation of residences. This plan is also partially disruptive to the generally pleasing aesthetic setting of the high bluffs overlooking the Mississippi River.

Channel Modification with Sediment Basin (Plan 10e-6). - This plan is similar to plan 10e-7, except that a 4.8-acre sediment basin is provided in the area between the Highway 14 and 61 bridge and the Mississippi River bottomland. The purpose of the sediment basin would be to reduce impacts on downstream water quality and to develop wetland habitat. It was determined that this basin would not be compatible with both flood control and habitat enhancement. Periodic sediment cleanout would be disruptive to the habitat in the area. Also, the concrete channel itself would reduce some sediment that presently enters State Road Coulee. The aesthetic effect of this shallow basin immediately adjacent to a residential development is also questionable.

Combination Reservoir Storage and Channel Modification (Plan 11). - This plan also does not contribute to many of the planning objectives discussed for the storage reservoir alternatives.

The combination plan of evacuation, flood proofing, and floodplain regulation (plan 6) requires a significant amount of land and relocation of residences and does not meet the specific planning objective of minimizing the land and relocations required. However, this plan provides the best nonstructural approach to flood damage reduction and will be included for further consideration.

The remaining alternative plans generally meet the specific objectives. However, the channel modification and diversion (alternative (plan 12) for State Road Coulee is generally similar to the channel modification alternative (plan 10e-7) since no practical diversion alignment was found that would significantly reduce modifications to most of the existing channel. Because plan 12 is more costly and requires more land and relocations than plan 10e-7, and because other environmental and social impacts are generally equal, plan 12 will not be considered further.

The plan of flood insurance (plan 4) provides compensation for those subjected to flood damages and the combination of this plan and floodplain regulation (plan 5) meets the goals of the specific planning objectives fairly well and merits further consideration

Based on the above discussions and on the requirements that each plan considered further should be economically feasible or be strongly supported, the following plans for State Road Coulee merit further consideration:

- a. Flood proofing (plan 3).
- b. Flood insurance and floodplain regulation (plans 4 and 5).
- c. Combination of evacuation, flood proofing, and floodplain regulation (plan 6).
- d. Permanent levee system (plan 9).
- e. Channel modification (plan 10e-7).

#### CONTRIBUTIONS OF ALTERNATIVES TO NATIONAL OBJECTIVES

##### GENERAL

The selected plan must satisfy specific objectives of the study area and show positive contribution to the national objectives of national economic development and environmental quality. To achieve a balanced plan which reflects society's dual concern for improving national economic efficiency while maintaining and enhancing the natural environment, a plan emphasizing the environmental quality objective and a plan emphasizing the national economic efficiency objective were developed.

##### NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN - STATE ROAD COULEE

The NED plan addresses the planning objectives while maximizing the net economic benefits. The following table compares the net annual benefits (annual benefits minus annual costs) of those alternatives selected for further consideration.

State Road Coulee - Comparison of net average annual benefits (1)

Item	Plan 3	Plans 4 and 5	Plan 6	Plan 9	Plan 10e-7
	Flood proofing	Flood insurance and floodplain regulation	Combination of evacuation, flood proofing, and floodplain regulation	Permanent levee system	Channel modification w/weir control
Net average annual flood control benefits	-\$183,000	-\$63,000	\$13,000	\$230,000	\$803,000
NED plan ranking	5	4	3	2	1

(1) Average annual benefits were computed using the current 7 3/8-percent interest rate for comparative purposes. The benefits include direct flood damage reduction and transportation benefits.

The channel modification alternative (plan 10e-7) maximizes net average annual benefits and constitutes the national economic development plan for State Road Coulee.

#### ENVIRONMENTAL QUALITY (EQ) - STATE ROAD COULEE

An EQ plan, like an NED plan, addresses the range of planning objectives but emphasizes contributions to aesthetic, ecological, and cultural values. Beneficial environmental quality contributions would be made by preserving, maintaining, restoring, or enhancing any significant cultural and environmental attributes of State Road Coulee. The table at the end of this section summarizes the impacts on major environmental quality considerations of the five alternative plans being considered further.

No single plan addressing State Road Coulee's flooding problems would contribute significantly to the environmental quality of State Road Coulee. Therefore, no EQ plan is designated for State Road Coulee.

The nonstructural alternatives (plans 3, 4, 5, and 6) have been evaluated with respect to their aesthetic, ecological, and cultural values to determine if they would provide significant benefit to environmental quality. The only alternative which was thought to have a net beneficial impact upon these values is floodplain regulation. Regulation of the floodplain would decrease crowding and provide open spaces which would be less unsightly than if the floodplain were left to be developed by residential, commercial, or industrial developers. A regulated floodplain would be more beneficial to ecological and cultural resources than would an unregulated floodplain, depending upon the development that would be allowed. Flood proofing of structures within the floodplain was found to have no beneficial impacts on any of the environmental values being considered. Flood proofing was considered to be unsightly both during and after construction. The perched appearance of elevated structures is aesthetically displeasing and, if a structure had some historical value, raising the structure could severely detract from its historical character. Since the majority of these structures are within urban areas, biological values of flood proofing are extremely limited.

Evacuation of the floodplain in conjunction with floodplain regulation (plan 6) would have some of the same benefits as discussed above. However, the benefits realized would only be equal to or less than the biological and cultural resources that could be lost in the relocation of these structures from the floodplain. If a biologically or culturally rich area were selected for development, the slight gain realized from floodplain evacuation and regulation would be severely offset by the adverse impacts of relocation. Floodplain evacuation would also have a negative impact on any significant historical structures within the floodplain. Evacuation would be unsightly during the evacuation process.

Although the floodplain regulation alternative is thought to have a beneficial impact, this impact is not considered to be significant in that this alternative is considered only to maintain the status quo and is not likely to have any measurable advantage over the future-without condition.

Plan 9, levee construction, would not adversely affect the Overhead archeological site but it would have the following impacts:

1. It would remove 9 acres of Mississippi River floodplain habitat.
2. It could aggravate trespass problems and adversely affect aquatic habitat in the Upper Mississippi River Wild Life and Fish Refuge.
3. It would increase turbidity and sedimentation of receiving waters during flood events on Pammel Creek.

Impacts associated with plans 10a, 10b, 10c, 10d, 10e-1, 10e-3, and 10e-5 are similar to those discussed above for plan 9. Although impacts on other resources would be nearly the same, plan 10e-2 would have a more severe impact than plan 9 because channel construction would destroy a portion of the Overhead site with a resulting loss of cultural data.

Plan 10e-6 would have fewer impacts on the floodplain than the other structural plans and would have no impact on the refuge, the overhead site, or endangered species. Although the design was developed from suggestions by the Fish and Wildlife Service and the Wisconsin Department of Natural Resources for possible development of wetland habitat, the achievement of beneficial habitat results is doubtful for the reasons discussed on page 56.

The selected plan 10e-7 is considered to be the least environmentally damaging structural plan. It is the result of planning efforts to reduce potential adverse effects on the significant environmental resources of State Road Coulee. Floodplain habitat losses would be minimized although the temporary water quality problems described above would remain. There would be no impacts on the refuge, Overhead site, or endangered species.

While there is no overall EQ plan for the State Road Coulee project, an EQ element was identified. This separable EQ element is related to an opportunity created by the recommended plan 10e-7 (reference ER 1165-2-28).

The EQ element of plan 10e-7 consists of acquisition and preservation as open space of approximately 42 acres of property west of the Burlington Northern tracks and south of Pammel Creek in lieu of replacing access to this area. This area contains the Overhead archeological site, which is listed in the National Register of Historic Places. The area also lies adjacent to the Upper Mississippi River Wild Life and Fish Refuge and could serve as a buffer area to the refuge because vehicular access could be restricted by removal of the existing bridge at station 19+65. The refuge is increasingly affected by illegal activities of trespassing, poaching, and unlawful woodcutting as urbanization encroaches on its boundaries. Damages from these activities are aggravated by the availability of vehicular access. The existing bridge at station 19+65 on Pammel Creek which provides access to the south of Pammel Creek and west of the Burlington Northern railroad tracks will be removed if plan 10e-7 is implemented. Plan 10e-7 does not call for bridge replacement but provides for an at-grade crossing of the Burlington Northern tracks south of Pammel Creek.

It is likely the cultural and natural resource values of this area will be lost within the life of the proposed project if the EQ plan is not implemented. The acute shortage of developable land in La Crosse will increase pressures to develop this property. The element would make a net beneficial contribution to the EQ account because significant cultural resources and wildlife habitat would be preserved that would otherwise be lost with the future without-plan condition.

The cost of the separable EQ measure could be split 75 percent Federal, 25 percent local under the fish and wildlife enhancement cost-sharing arrangement. The separable EQ element could be added to plan 10e-7 (see the table on page 80).

However, the possibility of actually implementing the EQ measure as a part of plan 10e-7 does not appear great at this time. The added cost of this element (acquisition) is approximately \$430,000, of which \$107,500 or 25 percent would be local costs. The 40-acre tract involved in this measure is privately owned and is zoned commercial property. The tract is currently outside the La Crosse city limits, but is in the process of being annexed. The tract will evidently be incorporated into the La Crosse boundary as "light industry" property. The city has expressed interest in purchasing the property on its own for use as an industrial park. The city has expressed no interest in this EQ element.

However, the local sponsor for the separable EQ measure does not have to be the same entity as that sponsoring the rest of the project. If another agency, organization, or institution would be willing to assume sponsorship of the EQ element, it may be considered further as a viable option.



State Road Coulee - environmental effects			
Plan 3	Phase 4 and 5	Plan 10-7	Plan 10-7
Environmental quality parameters	Flood proofing	Flood insurance and floodplain regulation	Remnant levee protection
Wild and Scenic Rivers	None designated to area	None designated to area	Remnant levee protection
Lakes	None in area	None in area	Remnant levee protection
Archaeological sites and/or historical sites	Minor adverse effect may result when these have been identified.	Floodplain regulation would not protect the overhead site from future development.	A historic site may be affected. However, the significance of this site has not yet been determined.
Cultural centers	None in area	None in area	None in area
Aesthetic values	Unlikely during construction. Some small flood proofing structures elevating structures resulting in ungravelled perched areas.	Development regulations may limit increased erosion. Existing levees and channels may be co-located and potentially displacing by some.	Concrete channels, even though located in flood proofing areas, may be considered as a historic site.
Land affected.	Floodplain area would increase slightly due to filling around elevated structures.	Little change from existing conditions.	Channel right-of-way would function as an open space.
Urban open space	Little change from existing conditions.	Little change from existing conditions.	Channel right-of-way would function as an open space.
Recreation	Little change from existing conditions.	Minor adverse effect during construction.	Channel right-of-way would function as an open space.
Air and noise pollution	Minor adverse effect during construction.	No effect.	Channel right-of-way would function as an open space.
Streambank erosion	No change from existing conditions.	No change from existing conditions.	Channel right-of-way would function as an open space.
Water quality	Minor adverse effect during construction (some soil lost to stream via storm sewers).	Minor long-term improvement due to floodplain regulation.	Channel right-of-way would function as an open space.

State Road Coulee - environmental effects (cont)

Environmental quality parameters	State Road Coulee - environmental effects (cont)			Channel modification
	Plan 3	Plans 4 and 5	Plan 6	
	Flood proofing	Flood insurance and floodplain regulation	Construction of evacuation, flood proofing and floodplain regulation	Permanent levee system
Biological resources	No change from those expected for existing conditions.	No rapid change from those expected for existing conditions.	Habitat gains in 40 acres of area evacuated (depending on type of future use). Habitat losses will occur in 40 acres of undeveloped area required for those evacuated.	Loss of 500 trees at downstream end of levee system. Temporary loss of 40 acres of herbaceous area on existing levees and adjacent residential and commercial property during construction. Vegetation would be restored on new levee system. Some habitat loss in 40 acres of resultant levelable residential and agricultural land.
Rare and endangered species	No change from existing conditions			
Terrestrial ecological systems	Temporary loss of some terrestrial wildlife populations during construction.	No rapid change from those expected for existing conditions.	Temporary loss of some terrestrial wildlife populations during construction. Terrestrial habitat loss in 40 acres of land to be relocated for 160 relocated residences.	Temporary loss of some terrestrial wildlife populations during construction. Loss of 2 acres of floodplain habitat.
Aquatic ecological systems	Minor adverse effect during construction (turbidity in stream via storm sewers).	No rapid change from those expected for existing conditions.	Minor adverse effect during construction (turbidity in stream via storm sewers). Minor long-term adverse effect due to floodplain regulation.	Temporary adverse effects during construction on existing aquatic system. River aquatic system downstream will provide minor long-term improvement after channel stabilization below plan outlet.
Habitat diversity and inter-generation	No change from those expected for existing conditions.	No change from those expected for existing conditions.	Some increase in diversity in 40 acres evacuated but a larger decrease in undeveloped area required for relocation.	Although ecological diversity in existing levee and channel area is low some additional habitat loss in diversity may occur.

Environmental quality of State Road Coulee

## SELECTING THE PLAN - STATE ROAD COULEE

The selection of a plan for State Road Coulee involves the identification and development of the best combination of national economic development benefits and environmental quality benefits. The identification of an NED plan for State Road Coulee in the previous paragraphs of this plan formulation section ranked the channel modification alternative (plan 10e-7) highest among considered solutions in the NED account. This plan ranks somewhat lower than the combination flood insurance and floodplain regulation alternative with respect to environmental quality.

The channel modification plan is a more practical plan in terms of local acceptance and economic feasibility and thus is considered to be a better plan. The other alternative solutions that generally meet the specific planning objectives will not provide a better mix of NED and EQ benefits since they rank lower in both of the national objectives. Therefore, the channel modification alternative is selected as the plan which would best satisfy the specific and national planning objectives. The following system of accounts table displays the most significant impacts of the NED plan, nonstructural plans 4 and 5, and the least environmentally damaging structural plan.

Item	System of accounts - State Road Coulee					
	NED plan		Floodplain regulation and flood insurance (nonstructural plans 4 and 5)		Channel modification - environmentally least damaging plan (plan 10e-7)	
	(channel modification - plan 10e-7) Within	State Road Coulee planning area	Outside of planning area	Total for nation	State Road Coulee planning area	Outside of planning area
	State Road Coulee planning area	Outside of planning area	Total for nation	State Road Coulee planning area	Outside of planning area	Total for nation

# ACCOUNTS

## I. NATIONAL ECONOMIC DEVELOPMENT

### A. Beneficial impacts

#### 1. Value of increased outputs of goods and services

a. Flood control (2)(5)(7)(9)*	\$2,178,700	0	\$2,178,700	0	0	\$2,178,000
b. Compensation for flood losses (2)(5)(7)(9)*	0	0	0	\$337,000	0	0
c. Other related benefits (location and advance bridge replacement benefits) (2)(5)(7)(9)*	93,500	0	93,500	0	0	93,500
2. Value of output from use of underemployed resources (1)(6)(8)(9)*	0	0	0	0	0	0
3. Total NED benefits	2,272,200	0	2,272,200	337,000	0	2,272,200

### B. Adverse impacts

#### 1. Project costs

a. Average annual cost (2)(6)(7)(9)*	100,000	\$1,365,000	1,465,000	84,000	253,000	337,000
b. Operation and maintenance (2)(5)(7)(9)*	4,000	0	4,000	63,000	0	63,000
2. Total NED costs	104,000	1,365,000	1,469,000	147,000	253,000	400,000
c. Net NED benefits			803,000			-63,000
d. Benefit-cost ratio			1.55			0.84

### D. Benefit-cost ratio

1.55

System of accounts - State Road Coulee (Cont)						
Channel modification - plan 10e-7			Floodplain regulation and flood insurance - (nonstructural plans 4 and 5)			
Within			Channel modification - environmentally least damaging plan (plan 10e-7)			
Item	State Road Coulee planning area	Outside of planning area	Total for nation	State Road Coulee planning area	Outside of planning area	Total for nation

## II. ENVIRONMENTAL QUALITY

### A. Environmental quality enhanced

1. Aesthetic values	Improved aesthetics from landscaped concrete channels as opposed to existing perched channel and levees. (1)(9)	No effect.	Same as planning area.	Regulations will limit increased crowding. (1)(9)	No effect.	Same as planning area.
2. Water quality	Concrete lining will eliminate erosion along channel.	Sedimentation in receiving waters will remain the same over long term.	-	Minor long-term improvement.	Negligible effect.	Sum of areas.

### B. Environmental quality degraded

1. Water quality*	Temporary adverse effect during construction due to increased turbidity. (1)(9)	Temporary adverse effect on small area of Mississippi River floodplain due to increased turbidity. (1)(9)	Sum of areas.	Negligible effect.	Negligible effect.	Same as planning area.
						Temporary adverse effect on small area of Mississippi River floodplain due to increased turbidity. (1)(9)

### C. Environmental quality destroyed

1. Floodplain habitat	Two acres of floodplain habitat.	No effect.	Same as planning area.	No effect.	No effect.	Same as planning area.
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System of accounts - State Road Coulee (cont)						
NED Plan		Floodplain regulation and flood insurance - Environmentally least damaging plan - channel modification (plan 10e-7)				
(channel modification - plan 10)		Within		Outside		
State Road Coulee planning area		State Road Coulee planning area	State Road Coulee planning area	State Road Coulee planning area	State Road Coulee planning area	Total for nation
Item						

### III. SOCIAL WELL-BEING

#### A. Beneficial impacts

##### 1. Health, safety, and well-being\*

About 90 percent of average annual flood damages would be prevented, 935 residential units and 3 businesses would no longer be in the 100-year floodplain. (1)(6)(7)(9)	Same as planning area	About 25 percent of average annual flood damages could be prevented by regulation of future floodplain uses. (2)(4)(7)(9)	Same as planning area	About 99 percent of average annual flood damages would be prevented, 935 residential units and 3 businesses would no longer be in the 100-year floodplain. (1)(6)(7)(9)	Same as planning area
Allows additional development of 43 acres close to business centers and at less cost than development of more rugged surrounding areas. (1)(6)(9)	Same as planning area	-	-	Allows additional development of 43 acres close to business centers and at less cost than development of more rugged surrounding areas. (1)(6)(9)	Same as planning area

##### 2. Local community patterns

Temporary disturbance during construction. (1)(9)	Same as planning area	No effect.	No effect.	Temporary disturbance during construction. (1)(9)	Same as planning area
Temporary disruption during construction. (1)(9)	-	No effect.	No effect.	Temporary disruption during construction.	-

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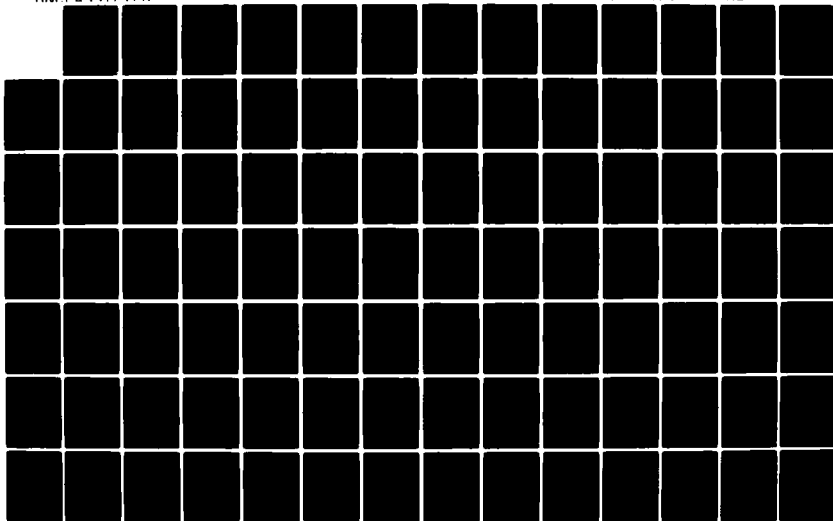
FLOOD CONTROL STATE ROAD AND EBNÉR COULEES LA CROSSE  
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ST PAUL DISTRICT APR 82

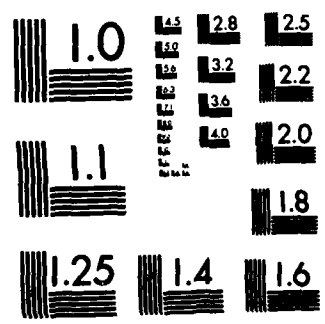
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System of accounts - State Road Coulee (cont)

Item	NED plan (channel modification - plan 10)			Floodplain regulation and flood insurance - nonstructural plans 4 and 5			Environmentally least damaging plan - channel modification (plan 10e-7)		
	Within			Within			Within		
	State Road Coulee planning area	Outside of planning area	Total for nation	State Road Coulee planning area	Outside of planning area	Total for nation	State Road Coulee planning area	Outside of planning area	Total for nation

IV. REGIONAL DEVELOPMENT

A. Beneficial impacts

1. Increased income	Potential flood damages are greatly reduced, thus decreasing repair expenditures. (1)(6)(8)(9)	Temporary increase during construction. (1)(6)(8)(9)	Sum of areas.	Potential added future flood damages are reduced. (1)(5)(8)(9)	No effect.	Same as planning area.	Potential flood damages are greatly reduced, thus decreasing repair expenditures. (1)(6)(8)(9)	Temporary increase during construction. (1)(6)(8)(9)	Sum of areas.
2. Employment gain	No effect.	No effect.	No effect.	No effect.	No effect.	No effect.	No effect.	No effect.	No effect.

B. Adverse impacts

1. Decreased income	Minor decrease in tax base by acquisition of 3 acres of private land mostly offset by increased value of flood protected land. (1)(9)	Same as planning area.	Same as planning area.	Negligible effect.	Negligible effect.	Same as planning area.	Minor decrease in tax base by acquisition of 3 acres of private land mostly offset by increased value of flood protected land. (1)(9)	Same as planning area.	Same as planning area.
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Timing

- (1) Impact is expected to occur prior to or during implementation of the plan.
- (2) Impact is expected within 15 years following plan implementation.
- (3) Impact is expected in a longer time frame (15 or more years following implementation).

Uncertainty

- (4) The uncertainty associated with the impact is 50 percent or more.
- (5) The uncertainty is between 10 and 50 percent.
- (6) The uncertainty is less than 10 percent.

Exclusivity

- (7) Overlapping entry; fully monetized in NED account.
- (8) Overlapping entry; not fully monetized in NED account.

Actuality

- (9) Impact will occur with implementation.
- (10) Impact will occur only when specific additional actions are carried out during implementation.

Section 122

- \* Items specifically required in Section 122 and ER 1105-2-105.

## EBNER COULEE ALTERNATIVES

The following table summarizes the effects of various alternative plans for Ebner Coulee on the specific planning objectives.

Table 1. Effects of alternative plans on specific planning objectives

	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10	Plan 11	Plan 12	Plan 13
	Emergency evacuation	Flood proofing	Flood insurance	Floodplain regulation	Combination of plans 2, 3, 5	Land treatment	Reservoirs with included conduit	Normal levee action	Channel modification	Channel modification	Channel modification	Channel modification	Channel modification
<b>Specific planning objectives</b>													
<b>A. Significant flood damage reduction or compensation (percent reduction in average annual damages)</b>	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	(0)	(34)	(75)	?	(75)	?	(57)	(70)	(69)	(70)	(90)	(70)	(70)
<b>B. Minimize lands and relocation's required (land required, acres) (residences relocated) (businesses relocated)</b>	Yes	No	Yes	Yes	No	Yes	Acceptable level	No	Yes	Yes	Acceptable level	Yes	Yes
	(0)	(105)	(0)	(0)	(24)	?	(23)	(44)	(15)	(15)	(33)	(14)	(14)
	(0)	(370)	(0)	(0)	(45)	(0)	(2)	(22)	(9)	(9)	(5)	(1)	(1)
	(0)	(7)	(0)	(0)	(0)	(0)	(2)	(3)	(0)	(0)	(2)	(0)	(0)
<b>C. Preserve or enhance area aesthetics</b>	Yes	Yes	No	Yes	Yes	Yes	Partially disruptive	Yes	Yes	Yes	Partially disruptive	Yes	Yes
<b>D. Compatible with overall land use planning for the LA C-20 area</b>	No	No	Yes	Yes	Moderately compatible	Yes	Moderately compatible	Yes	Yes	Yes	Moderately compatible	Yes	Yes
<b>E. Minimize safety hazards associated with steep watersheds</b>	No	No	Moderate reduction	No	Moderate reduction	No	Major reduction	Major reduction	Major reduction	Major reduction	Major reduction	Major reduction	Major reduction
<b>F. Minimize adverse impacts on fish and wildlife habitat including effects on Upper Mississippi River Refuge</b>	Yes	Yes	Yes	Yes	Habitat losses for relocations	Yes	Habitat losses for relocations	No	No	No	Habitat losses for relocations	Yes	Yes
<b>G. Avoid or minimize impacts on overhead archaeological sites</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Habitat losses for relocations	Yes	Yes

Based on these effects the following alternatives were omitted from further consideration:

- No action. - The no action alternative describes existing conditions. However, as a minimum, current State law requires that floodplain regulations must be adopted by the county or local governments, and thus the no action alternative without floodplain regulation cannot be considered.
- Early emergency warning system (plan 1). - Like State Road Coulee, Ebner Coulee has a high potential for rapid runoff and sufficient warning time cannot be relied upon with available warning systems.
- Total evacuation (plan 2). - This plan requires the relocation of an extensive area and is not compatible with the overall land use planning for the La Crosse area. Other alternative plans would minimize the need for lands and relocations.
- Land treatment (plan 7). - This plan cannot provide any major reductions in existing flood damages or significantly reduce the safety hazards associated with rapid runoff.
- Permanent levees (plan 9). - This plan does not minimize lands required for the levee system or the relocations of residences to an acceptable degree. In addition, the plan is not economically justified using the current 7 3/8-percent interest rate and is omitted from further consideration.

The remaining plans considered for Ebner Coulee generally meet the specific objectives or have effects which are not as significant as those of the alternatives described above. The combination plan of evacuation, flood proofing, and floodplain regulation (plan 6) is

similar to the flood proofing alternative (plan 3) in that only a moderate amount of land and relocation of residences is required. Only the combination plan will be considered further since the flood proofing plan is more costly. Also, the alternative solutions of a storage reservoir (plan 8) and a combination of reservoir storage with channel modification (plan 11) are similar plans. The small concrete channel used in plan 11 to replace and provide additional capacity over the existing ditch and storm sewer system is not considered a significant change between the above two plans. Thus, only the combination of reservoir storage and channel modification will be considered further since the storage reservoir alone provides less net economic benefits. The channel modification alternative (plan 10c) and the channel modification and diversion alternative (plan 12) have significantly different areas of impact, so both plans will be considered further.

The earth channel alternative (plan 10a) is less costly than the concrete channel modification plan (10c), but does not meet the specific planning objective of minimizing the lands and relocations required. Therefore, plan 10c is the most acceptable of the channel modification alternatives 10a to 10d for Ebner Coulee. Plan 12 for Ebner Coulee is less costly than all plan 10 channel modification plans.

Based on the above discussions, the following plans for Ebner Coulee merit further consideration:

- a. Flood insurance and floodplain regulation (plans 4 and 5).
- b. Combination of evacuation, flood proofing, and floodplain regulation (plan 6).
- c. Channel modification (plan 10c).
- d. Reservoir storage and channel modification (plan 11).
- e. Channel modification and diversion (plan 12).

#### NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN - EBNER COULEE

The table on page 91 compares the net annual economic benefits (annual benefits minus annual costs) of those alternatives selected for further consideration. The channel modification and diversion alternative (plan 12) ranks first of five plans shown in net average annual benefits and constitutes the NED plan for Ebner Coulee. However, neither the NED or the other four plans for Ebner Coulee shows economic feasibility.

Ebner Coulee - comparison of net average annual benefits

Lower cost alternative comparison of net average annual benefits					
	A	B	C	D	E
Plan	Flood insurance and floodplain regulation (plans 4 and 5)	Combination evacuation, flood proofing, and floodplain regulation (plan 6)	Channel modification (plan 10c)	Reservoir storage and channel modification (plan 11)	Channel modification and diversion (plan 12)
Net average annual benefits	-\$42,000	-\$387,000	-\$263,000	-\$130,000	-\$37,000
NED plan ranking	2	5	4	3	1

## ENVIRONMENTAL QUALITY (EQ) PLAN - EBNER COULEE

As previously discussed, an EQ plan emphasizes contributions to aesthetic, ecological, and cultural values. Beneficial environmental quality contributions would be made by preserving, maintaining, restoring, or enhancing any significant cultural and environmental attributes of Ebner Coulee. The preliminary environmental evaluation conducted for this study indicates that the impacts of the various alternative flood control solutions are generally minimal in the Ebner Coulee area subject to major flood damages. The Ebner Coulee drainage course and adjacent floodplain have previously been altered by urban development and measures to provide drainage and flood control. Most of the impacts of the alternatives considered would involve the developed areas in the lower portion of the Ebner Coulee drainage area. The existing development has previously altered the natural environment of this area. In addition, the development of this area has not provided any known cultural, historical, or archeological attributes. The following table summarizes the effects of the five alternative plans considered further on major environmental quality considerations. The environmental ranking of these alternatives was largely based on the factors discussed in the following paragraphs.

State College Environmental Action

Environmental quality parameters	Plans 1 and 5		Plan 10c		Channel modification	Reservoir storage and channel modification	Channel modification and diversion
	Flood insurance and floodplain regulation	Combination of evacuation, flood proofing, and floodplain regulation	Channel modification	Reservoir storage and channel modification			
Wild and scenic rivers			None in area	None in area			
Lakes			None in area	None in area			
Archaeological and/or historical sites			Unknown	Unknown			
Cultural centers			None in area	None in area			
Aesthetic values	Development regulations may limit increased crowding. Existing channel and levee may be considered aesthetically displeasing by some.	Unsettled during evacuation and flood proofing. Minor adverse aesthetic impact of flood proofing residences. Areas where residences are relocated may be aesthetically displeasing.	Concrete channels, even though landscaped, may be considered aesthetically displeasing by some.	Concrete channels, even though landscaped, may be considered aesthetically displeasing by some.	Concrete channels, even though landscaped, may be considered aesthetically displeasing by some.	Concrete channels, even though landscaped, may be considered aesthetically displeasing by some.	Concrete channels, even though landscaped, may be considered aesthetically displeasing by some.
Land affected	Little change from existing conditions.	Revegetated open space and park could occur evacuated area (about 2 percent of floodplain). Unlevelled areas may be levelled to accommodate many of the 15 evacuated residences.	Concrete channels would occupy about 6.3 acres more than existing channel and levees (total of 6.3 acres). About 2 acres of additional right-of-way is required. About 10 acres of existing urban levee would no longer be in the floodplain.	Concrete channels would occupy about 6.3 acres more than existing channel and levees (total of 6.3 acres). About 2 acres of additional right-of-way is required. About 10 acres of existing urban levee would no longer be in the floodplain.	Concrete channels would occupy about 2 acres more than existing channel and levees (total of 4 acres). The flood surface along the in-closed embankments (5 acres) would be restored to pre-project conditions. About 115 acres of existing urban development would no longer be in the floodplain.	Concrete channels would occupy about 2 acres more than existing channel and levees (total of 4 acres). The flood surface along the in-closed embankments (5 acres) would be restored to pre-project conditions. About 115 acres of existing urban development would no longer be in the floodplain.	Concrete channels would occupy about 2 acres more than existing channel and levees (total of 4 acres). The flood surface along the in-closed embankments (5 acres) would be restored to pre-project conditions. About 115 acres of existing urban development would no longer be in the floodplain.
Urban open space	Little change from existing conditions.	Evacuated area of 10 percent would be available as open space.	Channel right-of-way would be preserved as open space (25 acres).	Channel right-of-way would be preserved as open space (25 acres).	Channel right-of-way and ground surface above enclosed conduit would be preserved as open space.	Channel right-of-way and ground surface above enclosed conduit would be preserved as open space.	Channel right-of-way and ground surface above enclosed conduit would be preserved as open space.
Recreation	Little change from existing conditions.	Area evacuated (10 acres) could accommodate parks and trails.	Channel right-of-way would be partially accommodate biking and hiking trails.	Channel right-of-way would be partially accommodate biking and hiking trails.	Channel right-of-way could partially accommodate biking and hiking trails.	Channel right-of-way could partially accommodate biking and hiking trails.	Channel right-of-way could partially accommodate biking and hiking trails.
Air and noise pollution	No effect.	Minor adverse effect during construction.	Minor adverse effect during construction.	Minor adverse effect during construction.	Minor adverse effect during construction.	Minor adverse effect during construction.	Minor adverse effect during construction.
Stream-bank erosion	No change from existing conditions.	No change from existing conditions.	Temporary erosion during construction. Some long-term improvement due to increased channel stability.	Temporary erosion during construction. Some long-term improvement due to increased channel stability.	Temporary erosion during construction. Some long-term improvement due to increased channel stability.	Temporary erosion during construction. Some long-term improvement due to increased channel stability.	Temporary erosion during construction. Some long-term improvement due to increased channel stability.



**Enber Coulee environmental effects (cont.)**

Environmental quality parameters	Plans 4 and 5		Plan 6		Plan 10c		Plan 11		Plan 12	
	Flood insurance and floodplain regulation		Combination of evacuation, flood proofing, and floodplain regulation		Channel modification		Reservoir storage and channel modification		Channel modification and diversion	
Water quality	Minor long-term improvement due to floodplain regulation.	Enber Coulee is normally dry. Possible minor adverse effect during construction (some soil lost to stream via storm sewers). Minor long-term improvement due to floodplain regulation.	Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.		Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.	Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.	Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.	Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.	Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.	Possible occasional adverse effect during construction due to increased turbidity when excess rainfall runoff occurs. Minor long-term improvement due to decreased erosion and overbank flooding.
Biological resources	No change from those expected for existing conditions.	Some habitat pairs in area evaluated (11 acres) deemed suitable for future use. Habitat losses will occur in relocation of residence and development.	No change from existing conditions		Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).
Terrestrial ecological systems	No change from those expected for existing conditions.	Minor adverse effect during construction (turbidity carried to downstream river in storm sewers). Minor long-term improvement due to floodplain regulation.	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).		Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).
Aquatic ecological systems	No change from those expected for existing conditions.	Minor adverse effect during construction (turbidity carried to downstream river in storm sewers). Minor long-term improvement due to floodplain regulation.	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).		Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).
Habitat diversity and interdependence	No change from those expected for existing conditions.	Some increase in diversity in all areas evacuated but a decrease in areas required for relocation.	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).		Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).
Preservation of free choice for future resource use	No immediate change.	Some curtailment of future options for existing floodplain.	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).		Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).	Temporary loss of some mammal and resident bird populations during construction. Possible terrestrial habitat loss or degradation of land required for relocation of residences (maximum potential is 43 residences and 11 acres of land).

The flood insurance and floodplain regulation alternative (plans 4 and 5) would not change current conditions in the near future. The long-term character of the floodplain is uncertain because floodplain regulations may be a deterrent to major rebuilding and maintenance for some while being an incentive to others.

The combination evacuation, flood proofing and floodplain regulation alternative (plan 6) would require the relocation of 58 residences, resulting in the development of 10 to 15 acres of existing agricultural and undeveloped land. In addition, the flood proofing of about 343 residences to reduce basement damages would have a minor aesthetic impact. The long-term effect of floodplain regulations is uncertain.

The channel modification alternative (plan 10c) requires the relocation of nine residences. These relocations can be accommodated within the existing developed area. This plan would require about 15 acres of land in addition to 2 acres of existing channel and levees. Open channels with this plan would occupy about 8 acres. The aesthetic impact is not significant since the channel is relatively narrow, would be placed below ground level, and would be landscaped with shrubs and trees and a major portion of the channel would be adjacent to the existing P. & W. Northern railroad tracks.

The reservoir and channel modification alternative (plan 11) would require the relocation of two residences and two businesses. The businesses (nurseries) would require about 30 acres of agricultural or undeveloped land for relocation. The additional lands taken for the reservoir and channel would be about 33 acres. The reservoir might have an unappealing aesthetic impact on those residences located immediately adjacent to the embankment sections (maximum height is 15 feet).

The channel modification and diversion alternative (plan 12) requires the relocation of a fourplex and a garage and acquisition of about 7 acres of additional land. With this plan, open channels would occupy about 4 acres. The diversion of Ebner Coulee to the marshy area adjacent to the La Crosse River (Myrick Marsh) may have the minor long-term beneficial effect of increasing the rainfall runoff supply to the marsh. The existing marsh

is perched above the normal river levels, and the water supply to the marsh during the summer and fall seasons is obtained by rainfall runoff from the surrounding local drainage area. Overbank flows from the La Crosse River are rare during this time of year. A minor adverse effect would be the removal of less than 1 acre of trees just upstream of the marsh area. Most of the diversion works would be underground, causing a temporary impact during construction.

Two subareas south of Ebner Coulee contribute runoff to the floodplain area of Ebner Coulee. Thus, controlling only Ebner Coulee flows by the diversion works would reduce the existing 205-acre floodplain area to an area of 60 acres with remaining average annual flood damages of \$197,000. The Ebner Coulee drainage boundaries and subareas are shown on plate 5.

Added flood damage reduction for this area with plan 12 would require a supplemental channel starting from the area near the Ebner Coulee diversion works and extending south to join with State Road Coulee about 700 feet south of Ward Avenue. This channel could be located adjacent to the Burlington Northern railroad tracks before connecting to State Road Coulee. The channel would be a rectangular concrete channel varying in width from 10 to 11 feet. Ponding areas could be used within the public parkland areas to minimize the size of the channels.

These additional measures would cost about \$7.8 million or \$580,000 in average annual costs including operation and maintenance. Flood damage reduction benefits would be \$187,000 annually resulting in an incremental benefit-cost ratio of 0.32. These additional measures are not economically justified and would not help justify construction of plan 12.

Based on the evaluation of the effects listed in the preceding table and the environmental evaluation of the Ebner Coulee study area, it appears that the five alternative solutions considered further would have major environmental effects. However, no single plan addressing Ebner Coulee's flooding problems would make a net beneficial contribution to the EQ account; therefore, no EQ plan has been identified for Ebner Coulee.

## SELECTING THE PLAN - EBNER COULEE

The selection of a plan for Ebner Coulee involves the identification and development of the best combination of national economic development benefits and environmental quality benefits. The identification of the NED and EQ plans for Ebner Coulee has established the channel modification and diversion alternative (plan 12) as ranking highest in the NED account, but with negative net economic benefits. For the EQ account, this plan ranks second among the five plans considered, with the flood insurance and floodplain regulation (plans 4 and 5) ranking first environmentally.

The highest ranking alternative in the EQ account, flood insurance and floodplain regulation, is a nonstructural solution and provides more negative NED benefits than structural plan 12.

The alternative plan of channel modification (plan 10c) ranks third in the EQ and fourth in the NED ranking. Plan 10c would carry Ebner Coulee south in a concrete channel along the Burlington Northern railroad tracks to State Road Coulee. This plan would eliminate 99 percent of the potential annual flood damages but would provide less net benefits than those provided by plan 12. The high non-Federal costs of \$2.54 million and the relocation of nine residences make this plan less favorable to local interests. The plan of channel modification and diversion of Ebner Coulee (plan 12) without any additional modifications is considered the best structural plan for flood control. However, as stated earlier, the plan is not economically justified at the current 7 3/8-percent interest rate and so does not meet principal requirements for Federal participation.

The citizens advisory committee in 1976 did not recommend any plan for Ebner Coulee, citing marginal benefits even when four plans were previously economically justified using the authorized interest rate of 3 1/4 percent. However, the city of La Crosse now in 1980 places a higher priority on a structural solution for Ebner Coulee than for the State Road Coulee area. The city has expressed strong interest in resolving

2.7

the Ebner Coulee flood problem with or without Federal participation. A possible partial solution the city could apply would carry the Ebner Coulee 10-year design flow south to State Road Coulee in a 12-foot underground conduit. This proposal, if implemented by the city, would require a channel with approximately 10 feet of additional width for State Road Coulee from Broadview Place (station 53+60) to station 10+50.

The additional cost to enlarge State Road Coulee from station 53+60 to 10+50 would be approximately \$862,000. This amount would be mostly a Federal cost since no highway bridges are involved. The Burlington Northern railroad bridge is a Federal cost responsibility, and the State Highway 14 and 61 bridge should be adequate to incorporate an additional 10 feet of channel width. Relocation of the existing 72-inch storm sewer outlet that serves Ebner Coulee and enters State Road Coulee would probably be involved, but the relocation would probably be handled by the city if it constructed the 12-foot conduit parallel to this pipe. The benefit-cost ratio of 1.55 for the proposed State Road Coulee project would be reduced to 1.48 with this proposal (taking no benefits for any Ebner Coulee flood reduction).

The city would have to make a formal commitment to the St. Paul District if it intends to proceed with this proposal before phase II design work. This commitment must be made prior to the phase II general design conference so that the extra width could be incorporated in the final State Road Coulee channel design. Otherwise the city would be precluded from adding Ebner Coulee flows into the present size State Road Coulee design channel.

In summary, the current recommended plan for Ebner Coulee is a combination of plans 4 and 5, flood insurance and floodplain regulation. The following system of accounts table displays the most significant impacts of the NED structural plan, the environmentally preferable plan, and the best overall structural plan.

Item	System of accounts - Ebner Coulee					
	Nonstructural plan (floodplain regulation and flood insurance - plans 4 and 5)			NED structural plan and selected plan (channel modification & diversion-plan 12)		
	Within			Within		
	Ebner Coulee planning area	Outside of planning area	Total for Nation	Ebner Coulee planning area	Outside of planning area	Total for Nation

# ACCOUNTS

## I. NATIONAL ECONOMIC DEVELOPMENT

### A. Beneficial impacts

1. Value of increased outputs of goods and services

a. Flood control

(2) (5) (7) (9) \*

b. Compensation for flood losses

(2) (5) (7) (9) \*

c. Other related benefits (Location & advance bridge replacement benefits)

(2) (5) (7) (9) \*

2. Value of output from use of underemployed resources

(1) (6) (8) (9) \*

3. Total NED benefits

B. Adverse impacts

1. Project costs

a. Annualized first costs

(2) (6) (7) (9) \*

b. Operation and maintenance

(2) (5) (7) (9) \*

2. Total NED costs

C. Net NED benefits

D. Benefit-cost ratio

System of accounts - Ebner Coulee (cont.)					
Item	Nonstructural plan (floodplain regulation and flood insurance - plans 4 and 5)		NED structural plan and selected plan (channel modification & diversion-plan 12)		Total for Nation
	Within Ebner Coulee planning area	Outside of planning area	Within Ebner Coulee planning area	Outside of planning area	

## II. ENVIRONMENTAL QUALITY

### A. Environmental quality enhanced

#### 1. Aesthetic values

Regulations will limit increased crowding. (1)(9)	No effect.	Same as planning area.	Aesthetic improvement from landscaped concrete channel and buried conduits as opposed to existing perched channel and levees. (1)(9)	No effect.	Same as planning area.
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#### 2. Water quality

Minor long-term improvements. (1)(9)	Negligible effect.	Sum of areas.	-	-	-
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### B. Environmental quality degraded

#### 1. Water quality

Negligible effect.	Negligible effect.	Sum of areas.	Temporary adverse effect during construction due to increased turbidity. (1)(9)	Temporary adverse effect on small area of La Crosse River floodplain due to turbidity. (1)(9)	Sum of areas.
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#### 2. Aesthetic values

### C. Environmental quality destroyed

#### Floodplain forest

No effect.	No effect.	No effect.	Loss of about 1 acre of wooded area and 2 acres of herbaceous area. (1)(6)(9)	-	Same as planning area.
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System of accounts - Ebner Coulee

Nonstructural plan (floodplain regulation and flood insurance - plans 4 and 5) NED structural plan and selected plan (channel modification & diversion-plan 12)

Within

Ebner Coulee Outside of planning area Total for Nation Ebner Coulee Outside of planning area Total for Nation

Item

III. SOCIAL WELL-BEING

A. Beneficial impacts

1. Health, safety, and well-being\*

About 25 percent of average annual damages could be prevented by regulation of future uses. (2)(4)(7)(9)

Same as planning area.

About 70 percent of average annual flood would be prevented, 486 residential units and 1 business would no longer be in the 100-year floodplain. (1)(6)(7)(9)

Same as planning area.

2. Local community patterns

Allows additional development of 12 acres close to business centers and at less cost than development of more rugged surrounding areas. (1)(6)(9)

Same as planning area.

B. Adverse impacts

1. Noise

No effect.

No effect.

Temporary disturbance during construction. (1)(9)

Same as planning area.

2. Local community patterns

No effect.

No effect.

Temporary disruption during construction. (1)(9) Minor disturbance during construction. (1)(9)

Same as planning area.



System of accounts - Ebner Coulee (cont.)				
Item	Nonstructural plan (floodplain regulation and flood insurance - plans 4 and 5)		NED structural plan and selected plan (channel modification & diversion-plan 12)	
	Within planning area	Outside of planning area	Within planning area	Outside of planning area
	Ebner Coulee	Total for Nation	Ebner Coulee	Total for Nation

#### IV. REGIONAL DEVELOPMENT

##### A. Beneficial impacts 1. Increased income

Potential added future flood damages are reduced. (1)(5)(8)(9)	No effect.	Same as planning area.	Potential flood damages are greatly reduced, thus decreasing repair expenditures. (1)(6)(8)(9)
---	------------	------------------------	---

##### 2. Employment gain

No effect.	No effect.	No effect.
------------	------------	------------

##### B. Adverse impact Decreased income

Negligible effect.	Negligible effect.	Minor decrease in tax base by loss of 8 acres of private land mostly offset by increased value of flood protected land. (1)(9)
--------------------	--------------------	--

Timing: (1) Impact is expected to occur prior to or during implementation of the plan.  
(2) Impact is expected within 15 years following plan implementation.  
(3) Impact is expected in a longer time frame (15 or more years following implementation).

Uncertainty: (4) The uncertainty associated with the impact is 50 percent or more.  
(5) The uncertainty is between 10 and 50 percent.  
(6) The uncertainty is less than 10 percent.

Exclusivity: (7) Overlapping entry; fully monetized in NED account.  
(8) Overlapping entry; not fully monetized in NED account.

Actuality: (9) Impact will occur with implementation.  
(10) Impact will occur only when specific additional actions are carried out during implementation.

Section 122: \* Items specifically required in Section 122 and ER 1105-2-105.

## DEVELOPMENT OF THE RECOMMENDED PLAN

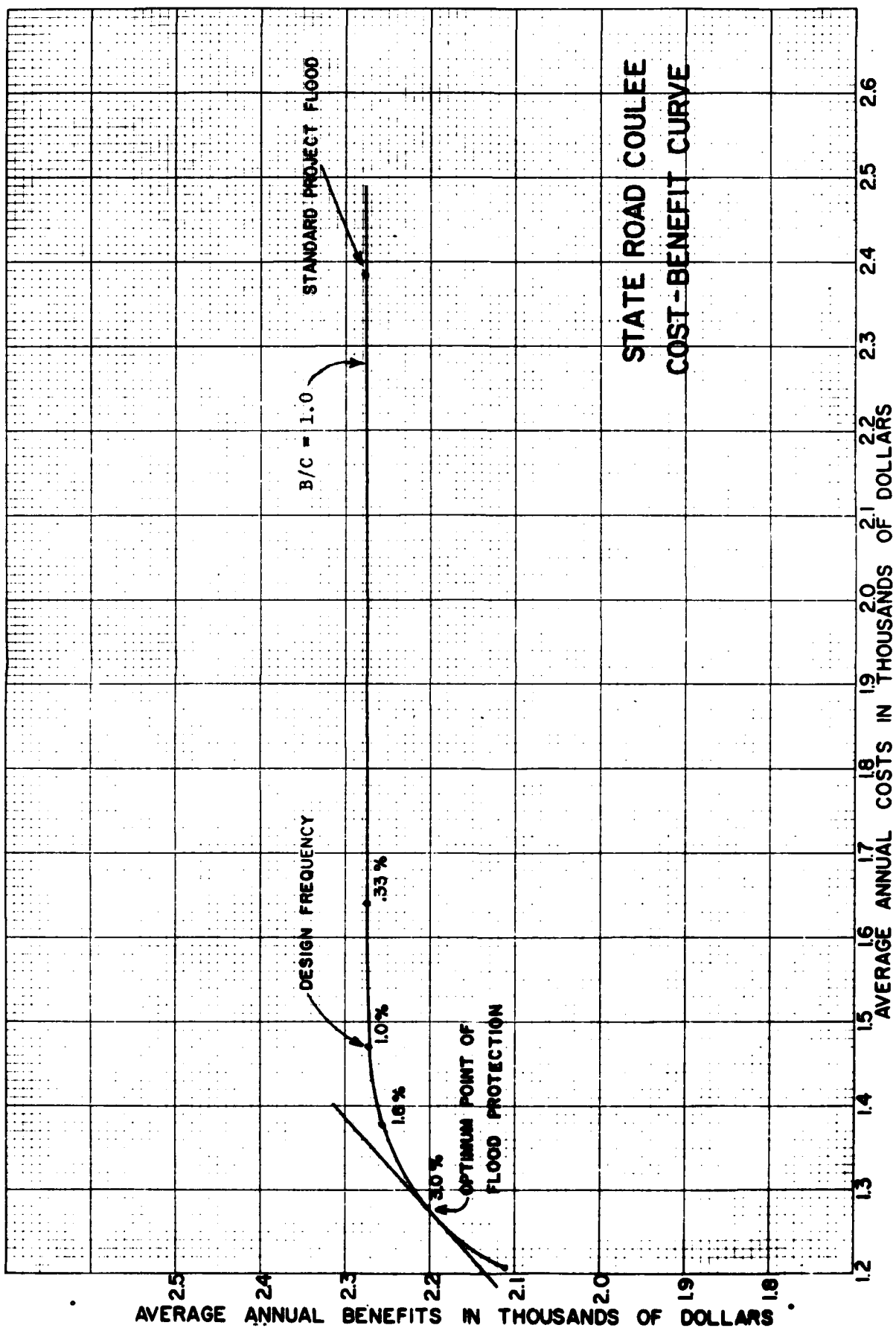
### GENERAL

Development of a plan to recommend for implementation requires further consideration of the alternative solution selected as the best overall plan for State Road Coulee. The selected plan requires examination of the economic, environmental, and social aspects at various levels of project design to determine the optimum level of development. Also, partial changes to the basic plan which improve the economic, environmental, and social aspects will be incorporated.

### STATE ROAD COULEE PLAN

#### Site Development Optimization

The optimum level of flood protection was determined by examining the economic, environmental, and social aspects of four different channel modification design capacities. The annual costs and benefits were based on a 100-year economic life and an interest rate of 7 3/8 percent. The channel design capacities provided protection from floods with estimated 5.5-percent, 1.6-percent, 1-percent, and 0.33-percent frequencies of occurrence. The following figure is a graph of the economic optimum level of flood protection which occurs with a project designed to provide protection from a flood having a 3.0-percent chance of occurrence. The table on pages 105 through 107 provides economic, environmental, social, and regional impact data for the economic optimum design condition and four other levels of flood protection including protection from the standard project flood. The environmental impacts for various degrees of flood protection are essentially the same except for the size of the remaining floodplain area.



Comparative design levels - channel modification plan (plan 10e-7) - economic, environmental, and social impacts

State Road Coulee

5.5 percent design frequency 1.6 percent design frequency 1 percent design frequency 0.33 percent design frequency Standard project flood design

I. NATIONAL ECONOMIC DEVELOPMENT(1)

(A through G in \$1,000)

A. Total first cost 16,336 18,651 19,851 22,231 32,323

1. Federal first cost 15,258 17,420 18,547 20,414 29,482

2. Non-Federal first cost 1,078 1,231 1,304 1,817 2,842

B. Total annual O&M cost 4 4 4 4 4

1. Federal 0 0 0 0 0

2. Non-Federal 4 4 4 4 4

C. Total average annual cost 1,210 1,381 1,469 1,640 2,386

1. Federal 1,126 1,286 1,369 1,506 2,176

2. Non-Federal 84 95 100 134 210

D. Total average annual benefits 2,112 2,256 2,272 2,274 2,277

1. Flood damage reduction 2,079 2,223 2,239 2,241 2,244

2. Transportation 33 33 33 33 33

E. Net average annual benefits 902 875 803 587 -109

F. Remaining average annual flood damages 165 21 5 3 0

G. Benefit-cost ratio (interest rate = 7 3/8 percent) 1.75 1.64 1.55 1.39 0.95

II. ENVIRONMENTAL QUALITY

A. Woodland gained or lost (+/-acres)

1. Urban area 0 0 0 0 0

2. Uplands 0 0 0 0 0

3. Bottomlands 0 -1 -1 -2 -3

B. Herbaceous area (+/-acres)

1. Parks and public lands -4 -6 -6 -6 -8

2. Lawns -3 -5 -6 -7 -9

3. Pastures and cropland -1 -3 -5 -5 -5

C. Wetlands gained or lost (+/-acres) 0 -1 -1 -3 -5

Comparative design levels - channel modification plan (plan 10e-7) - economic, environmental, and social impacts (cont.)

State Road Coulee	5.5 percent design frequency	1.6 percent design frequency	1 percent design frequency	0.33 percent design frequency	Standard project flood design
-------------------	---------------------------------	---------------------------------	-------------------------------	----------------------------------	----------------------------------

II. ENVIRONMENTAL QUALITY (cont.)

D. Streams affected

1. Continuously flowing  
streams. Existing  
channelized

a. Channel affected  
(miles)

2.7                      2.7                      2.7                      2.7

b. Channel bottom gained  
or lost ( $\frac{1}{2}$  acres)

-6                      -6                      -6                      -6

2. Intermittent flow drainage  
course - existing natural  
drainage course

a. Drainage course gained  
or lost ( $\frac{1}{2}$  miles)

0                      0                      0                      0

b. Percent of total drainage  
course affected

0                      0                      0                      0

3. Effect on stream erosion  
and sedimentation

Minor decrease    Moderate decrease    Moderate decrease    Major decrease    Major decrease

4. Effect on stream water  
quality

-----None-----

5. Effect on stream water  
temperature

-----None-----

E. Effect on water table

-----Minor (lower)-----

F. Effect on scenic, recreation,  
or wilderness areas

-----Minor-----

G. Riparian corridors lost  
or gained

-----Minor-----

H. Wildlife management area and  
refuges lost or gained

-----No losses or gains-----

I. Effect on air quality

-----None-----

J. Rare, endangered, or threatened  
animal species affected

-----None-----

K. Rare or unique vegetation  
systems affected

-----None known in area-----

Comparative design levels - channel modification plan (plan 10e-7)-economic, environmental, and social impacts(cont.)

State Road Coulee	5.5 percent design frequency	1.6 percent design frequency	1 percent design frequency	0.33 percent design frequency	Standard project flood design
-------------------	---------------------------------	---------------------------------	-------------------------------	----------------------------------	----------------------------------

## II. ENVIRONMENTAL QUALITY (cont.)

L. Historical and/or archeological sites affected

-----Possible impact on small (50-square meter) archeological site-----

M. Effect on cultural centers

-----No centers in affected area-----

## III. SOCIAL WELL-BEING

A. Area remaining in floodplain (acres) (2)

29

B. Flood protection

1. Residences protected(3)

746

2. Businesses protected (including farmsteads)

3

3. Persons protected

2,600

4. Total urban flood damage reduction (percent)

99

C. Relocations required

1. Residences

0

2. Businesses (including farmsteads)

0

3. Persons

0

4. Highways and streets (miles)

0.2

5. Utilities (miles)

0.2

a. Sewers (storm and sanitary)

0.3

b. Water lines

0.7

c. Communication lines

1.3

d. Power lines

0.5

D. Lands required (acres)(4)

1. Public

1

2. Private

0

a. Residential

2

b. Business including crop

0

3. Park and open space

0

4. Other

0

E. Bridge modifications or removal

4

F. Roads severed

0

G. Socially important sites affected

-----None presently known-----

Comparative design levels - channel modification plan (plan 10e-7) - economic, environmental, and social impacts (cont.)

State Road Coulee	5.5 percent design frequency	1.6 percent design frequency	1 percent design frequency	0.33 percent design frequency	Standard project flood design
-------------------	---------------------------------	---------------------------------	-------------------------------	----------------------------------	----------------------------------

III. SOCIAL WELL-BEING (cont.)

H. Effect on community patterns	Minor				
I. Effect on public health hazards associated with flooding	Minor improvement	Minor improvement	Moderate improvement	Moderate improvement	Major improvement
J. Effect on public safety hazards associated with flooding	Minor improvement	Moderate improvement	Major improvement	Major improvement	Major improvement
K. Effect on recreation opportunities	None				
1. Hunting	None				
2. Fishing	None				
3. Hiking and biking	Potential increase				
4. Picnicking and camping	None				

IV. REGIONAL ECONOMIC DEVELOPMENT

A. Effect on tax base	Minor loss				
B. Effect on recreation expenditures	Potential increase				
C. Effect on regional economic growth					
1. During construction	Increase				
2. During project life	Increase				

(1) Average annual costs and benefits were computed using an interest rate of 7 3/8 percent.

(2) The channel area required to convey the design flow is included.

(3) The figures include direct structural damage reduction to 746 residences and remaining residential units receive a reduction in damage to surrounding grounds and in access problems. The figures include those structures within the 100-year frequency floodplain. An additional 381 structures are located within the standard project flood outline.

(4) The figure shown are those lands required in addition to the area occupied by the existing channel and levees.

The economic optimum design would not contain the 1-percent chance flood, which is generally considered the minimum acceptable level of protection for an urban area. A channel modification plan providing protection from the 1-percent chance flood is economically feasible and is therefore considered an achievable level of protection, considering local acceptability and social and environmental impacts.

#### Standard Project Flood Considerations

The standard project flood is considered to be that flood resulting from the most severe combination of meteorological and hydrological conditions considered reasonably characteristic of the geographical area in which the drainage basin is located. The table on pages 105 through 107 includes impact data for protection against the standard project flood for a channel modification plan (enlarged version of plan 10e-7). The following table provides a summary comparison of the impacts of a single occurrence of the standard project flood for four conditions: without a project; with a project designed for the 1-percent chance flood; with a project designed for the 0.33-percent chance flood; and with a project designed for the standard project flood. The with and without project conditions flood profiles for State Road Coulee are shown on plates 6, 4-5, 4-6, and 7.4.

State Road Coulee - impacts from a single occurrence of the standard project flood

Item	Without project conditions	With project conditions		
		100-year flood design	300-year flood design	Standard project flood design
Total damage (\$1,000)	8,800	1,000	800	0
Residential units in flooded area	1,127	292	244	0
Residential units damages	938	192	153	0
Area flooded (acres)	425	120	95	0
Flood protection				
Residences protected	-	746	784	938
Businesses protected	-	1	1	3
Persons protected	-	1,700	1,785	2,135
Total flood damage reduction (percent)	-	89	91	100



The benefits derived by increasing the level of flood protection to include the standard project flood as compared to protection from the 1-percent chance flood are minimal. The increase in average annual costs of \$917,000 provides a reduction in average annual flood damages of only \$5,000. The impact of a single occurrence of the standard project flood with a channel modification project in place sized to contain the 1-percent chance flood is relatively minor. Damages would be less than 1 percent of the without project condition damages. The increased non-Federal first costs of about \$1,538,000 are of great concern to the local sponsor. Thus, on the basis of the above information, the channel modification plan providing protection from the 1-percent chance flood is considered to provide the best overall level of protection.

#### Level of Protection - Added Discussion

The 100-year flood was chosen as the design level of protection for State Road Coulee. The relationships between the 100-year, standard project flood (SPF), and other levels of protection were discussed in the previous sections. The comparison on page 105 shows the following:

Item	Cost benefit comparison		
	Protection level		
	100-year	300-year	SPF
Design discharge at Hagen Road (in cfs)	5,340	6,600	9,750
Total cost	\$19,851,000	\$22,231,000	\$32,323,000
Annual cost	1,469,000	1,640,000	2,386,000
Annual benefit	2,272,000	2,271,000	2,277,000
Benefit-cost ratio	1.51	1.39	0.95

The 100-year level of protection was chosen for the recommended plan because the SPF level was not economically feasible. A higher level of protection (300-year) was not considered justified because it would involve \$2.4 million added costs and because possible overtopping of this design 100-year flood channel does not present a severe hazard. The degree of overtopping

would not severely endanger the integrity of the 100-year design channel or cause major damage. (The State Road Coulee project is unlike a levee project in which overtopping can cause greater damage with a levee failure than would occur with no levee in place.)

Going to a higher level of protection would lead to substantial adverse impact on the Upper Mississippi River Wild Life and Fish Refuge. Without the project, flows entering the Mississippi River and the refuge from State Road Coulee are limited to 1,300 cfs by natural conditions. A 100-year level of protection would effectively increase this flow to 6,230 cfs with attendant increases in velocity. The 300-year and SPF flows would be even larger (7,720 and 9,750 cfs, respectively).

#### Public Safety Considerations

The basic plan for State Road Coulee would be very effective in flood damage reduction, eliminating 99 percent of all damages. Lessening of the coulee's effect on local flood, health, and safety factors would cause a major improvement in the social well-being of the adjacent area. Although community patterns would be temporarily disrupted, the benefits of the operational flood control plan would outweigh these temporary effects.

#### Aesthetic Considerations

The major aesthetic impacts and effects of the selected plan would occur directly in the project area. Improvements provided in the State Road Coulee area would include removal of unsightly channel growth, removal of earth levees, and landscaping of the right-of-way adjacent to the new channel. In addition, the concrete channel would reduce turbidity and erosion. The channel would be lower than the adjacent ground level, thus making its presence less conspicuous. Treatment of the concrete surfaces by rustication or other means would be explored more fully in the preparation of more detailed designs that would be presented in phase II of the general design memorandum studies.

### Mississippi River Effects

Mississippi River high water events seldom coincide with State Road Coulee floods. Mississippi River high water levels generally result from snowmelt, whereas State Road Coulee floods occur from large summer rainstorms. A more complete discussion of considered design criteria used for State Road Coulee is contained in appendix 4.

The Mississippi River 100-year flood elevation at the mouth of State Road Coulee is about elevation 640.9 feet msl (1929 adjustment). Almost all of the residential land along State Road Coulee is above this level. The exceptions are a one-block-square area along the east (left bank) of State Road Coulee near Broadview Place and 33d Street and an area less than one block square along the east (left bank) of State Road Coulee just upstream of the Burlington Northern railroad bridge.

The Mississippi River standard project flood elevation at the mouth of State Road Coulee is about 645.4 feet msl (1912 adj). Residential land on the left bank of State Road Coulee downstream of Meadow Lane Place (about station 72+00 along the channel center line of State Road Coulee) would be inundated by a flood of this magnitude. Mississippi River flood outlines are shown on plate 4-7 of appendix 4.

It is important to note that the recommended plan for State Road Coulee will not prevent any flooding now caused by the Mississippi River.

## COORDINATION AND PUBLIC INVOLVEMENT

Coordination among Federal, State, and local interests was a very important part of this design memorandum. Special coordination was maintained with the State Road-Ebner Coulee Citizens Advisory Committee during the initial 1974-1976 study period. The committee was composed of a uniform cross section of individuals from within the coulee areas and Shelby Township. Interested Federal and State agencies served as technical advisors to the committee. The coordination and public involvement information is described more fully in appendix 1.

A total of 10 citizens advisory committee meetings were held throughout the initial investigation. The committee provided valuable assistance in keeping the public fully informed about the status and progress of reformulation studies and actively solicited from all concerned citizens their opinions and views regarding possible solutions. Further, the committee provided a definite contribution in the selection of specific planning objectives and evaluation of all alternative solutions. All committee meetings were open to the public and pertinent information discussed at the meetings was disseminated through the news media.

The meetings culminated in adoption of a position paper by the committee. The committee recommended that channel modification be the basic approach to flood control for State Road Coulee. The committee recommended no action for Ebner Coulee, even though some alternatives were economically justified using the authorized interest rate of 3 1/4 percent. The committee cited marginal benefits for not recommending Ebner Coulee work. The committee did identify the plan of channel modification and diversion as the most acceptable plan for Ebner Coulee if an alternative solution were to be strongly pursued.

Five additional meetings were held with local and environmental interests in the 1978-1980 reevaluation phase (see appendix 1). As stated earlier, this second phase of study concentrated on reevaluating the selected plan and updating costs and benefits for alternatives developed in the initial

study phase. The city of La Crosse provided the principal local contact in the second phase because increased city awareness of critical flood control needs. The citizens advisory committee was not active in the second study phase.

All interested Federal and State agencies were informed of the initiation of both postauthorization phases of study and the formation of the citizens advisory committee in the first phase. A field tour of the project area was made in conjunction with one of the committee meetings to give the committee and interested representatives a better background for evaluating alternative plans.

#### RECOMMENDED PLAN - STATE ROAD COULEE

##### GENERAL

This section describes in detail the plan recommended to meet the water and related land resource needs of the lower reaches of State Road Coulee. This plan is essentially the same as the authorized project but has been modified in accordance with environmental considerations, technical design improvements, and adjustments in the scale of development. The recommended plan is shown on plates 5 and 6.

The recommended plan for State Road Coulee involves channel modification from Hagen Road to the confluence with the Mississippi River. The modifications would include a drop structure, a stilling basin, one junction structure, three new street bridges, one new railroad bridge, and modifications to sewer and water lines. The modifications required at each bridge location for State Road Coulee are shown on plate 7. (A fourth street bridge at Ward Avenue was recently rebuilt by the city and is no longer included in the plan.) The general channel alignment and profile is shown on plate 6. The State Road Coulee channel is designed to contain a flood having a 1-percent chance occurrence frequency.

## CHANNEL MODIFICATION

The proposed channel modification would essentially follow the present alignment of State Road Coulee downstream of the Hagen Road bridge. Conceptual views of the proposed channel are shown on plates 8, 9, and 10. Flows would enter the design channel through a drop structure located adjacent to the upstream side of Hagen Road bridge. Between Hagen Road bridge and the Burlington Northern railroad bridge, the modified channel would have a trapezoidal cross section to minimize right-of-way requirements and would be lined with 12 inches of concrete to protect the channel from anticipated high velocities and scour. This 2.3-mile long channel would have 2:1 side slopes with a bottom width varying from 20 feet in the upstream reaches to 30 feet near the Burlington Northern railroad bridge. A side channel inlet structure 400 feet downstream of the Hagen Road bridge would allow flow from the drainage area now served by a 9-foot high arch culvert. A stilling basin 1,400 feet downstream of Ward Avenue would reduce high velocities caused by the steep slopes in the upper part of the channel. A rectangular, concrete-lined channel, 80 feet wide and 600 feet long, would convey flows through the Burlington Northern railroad bridge and under the Highway 14 and 61 overpass.

Downstream of the rectangular channel, a riprap trapezoidal channel having a bottom width of 150 feet and a length of 650 feet (including transitions) would convey the flood flows to the east bank of the Mississippi River floodplain. A 164-foot-long riprap outlet control would be built at the end of the project, terminating about 1,100 feet downstream of the present Highway 14 and 61 bridge. The control, with a 238-foot wide crest, would allow the design flow to spread or "fan-out" into the Mississippi River floodplain. The control would have a 10-foot-wide bottom notch with 3:1 side slopes to handle low flows (see plate 6).

The channel capacity would vary from 5,340 cubic feet per second upstream to 6,230 cubic feet per second downstream of U.S. Highway 14 and 61. The present levees would be removed and the channel dropped sufficiently to enable surface runoff from the adjacent low-lying floodplain to drain directly into the channel. The channel width, including 25 feet of right-of-way for construction and maintenance purposes would vary from 83 feet to 255 feet from the upstream to near the downstream end of the project.

## BRIDGE RELOCATIONS

The proposed channel improvements for State Road Coulee would involve replacement or modification of several bridges. Most of the existing street and railroad crossings over State Road Coulee are in poor structural condition, are obsolete by today's highway standards and urban needs, and have inadequate waterway openings for safe passage of design flood flows. The bridge modifications would provide for safe and efficient crossing for residents and easy access to areas of present and potential urban development.

The construction of the proposed channel improvements on State Road Coulee would require a new bridge and a drop structure at Hagen Road (station 138+69) and a possible new bridge at Drive-In Road. The existing Drive-In Road bridge is relatively new and in good structural condition. However, with the excavation and construction of the proposed channel the abutment footings and pile bents would most likely be exposed and affect the strength of the structure. It is assumed for this study that a new bridge would be constructed. The proposed channel improvement would use the newly constructed (1980) bridge at Ward Avenue (station 101+30) but would require a new bridge at Broadview Plaza (station 53+60) and a new railroad bridge at station 21+46. Plate 7 shows all the proposed new bridges for State Road Coulee.

The design and construction costs of the three highway or road bridges mentioned in the previous paragraph are a local responsibility. The Burlington Northern bridge at station 21+46 would be replaced by the railroad, but would be a Federal cost.

The farm bridge at station 19+65 on State Road Coulee (plate 6) will be removed, and the single farm served by the bridge will be provided a new access road to Highway 14 and 61 south of State Road Coulee.

## UTILITY CHANGES

Public and private utilities at numerous locations will require modifications because of the proposed improvements. These modifications include changes in alignment and grade for utilities running parallel and crossing the proposed channel. Although no major construction problems are foreseen, coordination of utility relocation work by the various owners will probably be extensive. The sequence of relocation work will require considerable planning to minimize service disruptions in the area. The following table shows the approximate locations of all utility changes that will be required.

Utility changes required with proposed improvements			
Coulee	Utility	Size or description	Approximate location
State Road	<u>Public</u>		
	Water main	12-inch diameter	Greenhills Place
		12-inch diameter	Broadview Place
		8-inch diameter	Funk Road
		8-inch diameter	Ward Avenue
	Sanitary sewer	12-inch diameter	Greenhills Place
		10-inch diameter	Ward Avenue
		8-inch diameter	Hagen Road
	Storm sewer	36-, 72-, and 78-inch diameter	U.S. Highways 14 and 61
		Pump station	
		Discharge line	
		Modification	Birch Street
	<u>Private</u>		
	Power lines	Primary circuit	U.S. Highways 14 and 61
		Primary circuit	Greenhills Place
		Primary circuit	Broadview Place
		161 KV transmission line	Birch Street
		Lighting secondary	Park Lane Drive
		Primary circuit	Ward Avenue
		34.5 KV transmission line	Ward Avenue
		Primary circuit	Hagen Road
	Gas mains	3-inch	Broadview Place
		6-inch	Ward Avenue
	Telephone	Aerial cable	U.S. Highways 14 and 61
		Aerial cable	Greenhills Place
		Aerial cable	Greenhills Place to Meadow Lane
		Aerial cable	Ward Avenue to South
		Aerial cable	Ward Avenue
		Buried cable	Park Lane Drive
	CATV	Aerial cable	Hagen Road
		Local	Broadview Place
		Local	Ward Avenue
		Local	Hagen Road

The city of La Crosse owns all public utilities. Power lines and gas mains are owned by Northern States Power Company with the exception of one 34.5-kilovolt transmission line at Ward Avenue which is owned by Dairyland Power Cooperative. The La Crosse Telephone Company owns the communication lines, while the cable television lines are the responsibility of Teleprompter of La Crosse.

#### ENVIRONMENTAL CONSIDERATIONS

Significant environmental concerns have been addressed during development of the recommended plan in order to arrive at the least environmentally damaging structural plan. Elimination of the previously proposed earth pilot channel (plan E-5) through the Mississippi River floodplain significantly reduces the potential for adverse impacts on the floodplain.



Existing levees in residential areas of State Road Coulee would be removed and replaced with a concrete-lined channel. The removal of these levees and subsequent landscaping with trees and shrubs would improve the aesthetics of this area. A chain link fence would be provided to keep people, especially small children, from entering the concrete channel. Although the fence would not be an absolute barrier, it would prevent people from inadvertently or unknowingly entering the channel. Additional safety features such as steps in the channel sides or handholds would be desirable and would be incorporated in later investigations.

Several considerations to minimize the environmental impacts remain to be addressed. The U.S. Fish and Wildlife Service's stage 2 Fish and Wildlife Coordination Act Report of 5 November 1980 is included as exhibit 15 in appendix 1. The report contains seven conclusions and recommendations which are responded to here:

"1. The pilot, northwest, and southeast earth channel proposals downstream from the STH 14/61 overpass are unacceptable and should not be developed because they would cause significant damage to the stream, wetlands, and floodplain forest of Lower Pammel Creek and our refuge."

Response: The recommended plan does not include any of these features and should not cause significant damage to the stream, wetlands, and floodplain forest of lower Pammel Creek or the refuge.

"2. Any proposed alteration on refuge lands would be subject to our approval of right-of-way and determination of compatibility with refuge objectives."

Response: The recommended plan will terminate outside of refuge lands.

"3. Of the structural alternatives presented thus far in project planning, the riprapped channel (alternative 2) appears to best minimize adverse impacts to fish and wildlife resources."

Response: Alternative 2 basically constitutes the terminus features included in the recommended plan (10e-7).

"4. The stilling basin (alternative 1) has potential for wildlife enhancement; however, more detailed study would be necessary pertaining to the environmental concerns previously discussed before impacts could be predicted."

Response: The potential wildlife habitat enhancement features of the stilling basin (alternative 1 or plan E-6) are recognized. However, it is doubtful that management measures to implement the two objectives of flood control and wildlife habitat enhancement would be compatible. In addition, the other potential problems identified in the U.S. Fish and Wildlife Service's stage 1 report - fish entrapment, nuisance plant growth, and the availability of sufficient flow to sustain a wetland community - would reduce the overall environmental value of this alternative.

"5. Any access road built for channel maintenance should be on the right bank of Pammel Creek in the playground to avoid clearing floodplain forest in the left bank area."

Response: The location of an access road will be developed during more detailed phase II design studies. Every effort will be made to avoid impacts on the riparian vegetation of Pammel Creek.

"6. Disposal sites in wetlands and floodplains should be eliminated from further consideration."

Response: Exact locations of disposal sites will be determined during phase II studies. At that time, primary consideration will be given to upland sites. Selection of disposal areas will be coordinated with all concerned agencies and citizens to ensure that adverse environmental effects will be minimized. In addition, efforts will be made to locate potential users of excavated material to help reduce the disposal area required.

"7. To comply with section 7 of the Endangered Species Act of 1973, as amended, you should conduct a Higgin's eye pearly mussel survey and a bald eagle winter survey of the project area."

Response: Potential project impacts on Higgins' eye pearly mussels and bald eagles have been assessed (see section 5 of the draft EIS). Our analysis indicates that these species would not be adversely affected by the selected plan. Therefore, the suggested surveys do not appear necessary.

#### REAL ESTATE REQUIREMENTS

Local interests would be required to provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and subsequent maintenance of the project. Temporary easements and rights-of-entry necessary for project construction would also be furnished by local interests. At lateral ditch entrances, drop inlet structures, and along the improved channel reaches, local interests would acquire for their own use the rights-of-access and rights-of-way necessary to maintain the project works.

Total right-of-way required for State Road Coulee in addition to that now occupied by the existing channel and levee would be 4.1 acres. Of this total, 2.9 acres is agricultural, 0.5 acre is commercial, and 0.7 acre is public land.

## OPERATION AND MAINTENANCE

No elements of the project would require operation. However, maintenance of the flood-carrying capacity of the improved channel and maintenance of the drop structures, stilling basins, and the junction structure would be essential to ensure effective operation of the project and realization of the anticipated benefits. Project maintenance would be the responsibility of the local interests.

## COST ESTIMATES

### FIRST COSTS

An itemized breakdown of estimated project first costs, based on October 1980 prices, is presented in the following table.. Unit prices and lump sum costs in the estimate are based on recent prices used for similar work in the St. Paul District. Appropriate allowances for contingencies, engineering and design, and supervision and administration are included in the estimates. The estimated first cost for the total plan is \$19,560,000 for State Road Coulee modifications.

<u>Detailed estimate of first costs, State Road Coulee</u>				
<u>Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>Total estimated cost</u>
<u>Federal first costs</u>				
<u>Bridge relocations</u>				
Burlington Northern bridge at station 21+46	Sum	Job	-	\$458,300
<u>Utility relocations</u>				
Sanitary	Sum	Job	-	63,600
Water	Sum	Job	-	63,000
Gas	Sum	Job	-	14,800
Storm sewer	Sum	Job	-	<u>30,300</u>
Total utility relocations				171,700

Detailed estimate of first costs, State Road Coulee (cont)

Item	Unit	Quantity	Unit cost	Total - estimated cost
<u>Channels</u>				
Excavation	CY	589,800	\$2.20	1,297,600
Riprap	CY	11,820	30.00	354,600
Filter material	CY	9,800	11.00	107,800
Concrete, (including cement) (1)	CY	39,085	259.00	10,123,000
Reinforcing steel	Lb	598,500	0.50	299,300
Steel sheet-piling	Sq yd	2,400	16.00	38,400
Drop structure at station 139+80	Sum	Job	-	50,600
Trash rack at station 139+80	Sum	Job	-	29,600
Stilling basin at station 86+85	Sum	Job	-	87,300
Chain link fence	LF	24,440	9.00	220,000
Landscaping	Sq mi	4.63	14,800.00	68,500
Seeding	Ac	2.8	800.00	2,200
Contingencies				<u>2,544,200</u>
Total channels				15,233,100
Total direct construction cost				15,852,100
<u>Indirect cost</u>				
Total engineering and design (9.5 percent)				\$1,505,900
Supervision and administration (7.5 percent)				<u>1,188,700</u>
Total indirect cost				2,694,600
Total Federal first cost				18,546,700
<u>Non-Federal first cost</u>				
<u>Lands and damages</u>				
Fee title, public lands	Sum	Job	-	\$39,300
Fee title, cropland	Ac	2.9	\$8,700.00	38,500
Fee title, commercial	Ac	0.5	21,000.00	16,100
Contingencies				19,000
Acquisition costs				<u>3,400</u>
Total lands and damages				116,300
<u>Relocations</u>				
<u>Bridge relocations</u>				
Hagen Road (station 139+00)	Sum	Job	-	130,300
Drive-In Road (station 116+65)	Sum	Job	-	159,900
Broadview Plaza (station 53+60)	Sum	Job	-	182,000
Ramps to bridges	Sum	Job	-	78,400
Guardrail	Sum	Job	-	44,400
Contingencies				<u>162,800</u>
Total bridge relocations				757,800

Detailed estimate of first costs, State Road Coulee (cont)

<u>Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>Total estimated cost</u>
<u>Miscellaneous relocations</u>				
Power lines				40,000
TV cable				1,500
Telephone				112,500
Water main				60,700
Contingencies				<u>42,800</u>
Total miscellaneous relocations				257,500
Total relocation indirect costs (engineering, design, supervision, and administration)				172,600
Total relocation costs				1,187,900
Total non-Federal first costs				1,304,200
Total cost, State Road Coulee				<u>19,850,900</u>

COST ESTIMATE COMPARISONS

The following table compares cost estimates for the State Road Coulee and Ebner Coulee plans with previous estimates of first cost for the authorized plan. The cost estimate for the State Road Coulee recommended plan is shown in comparison also. The last two columns provide a current cost comparison for including and excluding Ebner Coulee from the originally authorized project.

Comparison of cost estimates, State Road and Ebner Coulees

Item	Project document	PB-3 estimate	Nov 1976 phase I design memorandum estimate		Current phase I design memorandum estimate	Recommended plan
	(3 1/4 percent interest rate, April 1966 price levels)	(3 1/4 percent interest rate, projected Oct 1975 price levels)	(3 1/4 percent interest rate, January 1975 price levels)	(7 3/8 percent interest rate, Oct 1980 price levels)	State Road Coulee (Oct 1980 price levels)	
FEDERAL COSTS						
Relocations - Burlington Northern Railroad Bridges	\$ 122,000	\$ 280,000	\$ 579,000	\$ 853,900	\$ 457,300	
State Road Coulee	(73,000)	(168,000)	(309,000)	(457,300)	(457,300)	
Ebner Coulee	(49,000)	(112,000)	(268,000)	(396,600)		
Channels (includes utility relocations)	5,733,000	13,120,000	15,014,000	23,906,000	15,404,800	
State Road Coulee	(3,530,000)	(8,078,000)	(9,881,000)	(15,404,800)	(15,404,800)	
Ebner Coulee	(2,203,000)	(5,042,000)	(5,135,000)	(8,501,200)		
Engineering and design	555,000	1,286,000	1,481,000	2,351,200	1,505,900	
Supervision and administration	439,000	1,014,000	1,169,000	1,856,000	1,188,700	
Supervision and inspection	(285,000)	(648,000)	(779,000)	(1,244,000)	(796,700)	
Overhead (33 percent)	(154,000)	(366,000)	(390,000)	(612,000)	(392,000)	
Total cost (Federal funds only)	6,849,000	15,700,000	18,243,000	28,956,700	18,546,700	
TOTAL NON-FEDERAL COSTS						
Lands and damages	185,000	422,000	514,000	786,400	116,300	
Relocations	325,000	748,000	1,434,000	1,853,700	1,187,900	
Total non-Federal costs	510,000	1,170,000	1,943,000	2,640,100	1,304,200	
SUMMARY OF ESTIMATED COSTS						
Federal costs	6,849,000	15,700,000	18,243,000	28,956,700	18,546,700	
Corps of Engineers	(6,849,000)	(15,700,000)	(18,243,000)	(28,956,700)	(18,546,700)	
U.S. Coast Guard			None			
Required non-Federal costs	510,000	1,170,000	1,948,000	2,640,100	1,304,200	
Cash contribution	(510,000)	(1,170,000)	(1,948,000)	(2,640,100)	(1,304,200)	
Other costs			None			
Total Federal and required non-Federal costs	7,359,000	16,870,000	20,191,000	31,596,800	19,850,900	

NOTE: Interest and amortization factor for 7 3/8 percent (100-year life) = 0.07381.  
Interest and amortization factor for 3 1/4 percent (100-year life) = 0.03383.

## ANNUAL CHARGES

To facilitate comparison with related project benefits and arrive at the project benefit-cost ratio, the following table shows the annual charges converted from total first cost plus subsequent project operation, maintenance, and replacement costs for the recommended plan. Annual costs are based on a 7 3/8-percent interest rate and a 100-year economic life. The interest rate used in the previous November 1976 draft phase I report was 3 1/4 percent. The 3 1/4-percent interest rate applied to authorized projects for which local sponsors had provided written assurances to pay the required non-Federal share of project costs by 31 December 1969. That assurance was received from La Crosse County by letter dated 10 November 1969. However, planning was halted and the project was reclassified "inactive" on 7 April 1977 when local sponsors advised the District that they would not assume local cooperation responsibilities.

Renewed local support for the project through July and September 1978 resolutions by the town of Shelby, city of La Crosse, and La Crosse County resulted in reactivating the project. However, since the project sponsors withdrew support after 31 December 1969, the current interest rate of 7 3/8 percent now applies.

Estimated annual charges (October 1980 prices)	
Item	Charges
<u>State Road Coulee</u>	
Total economic investment <sup>(1)</sup>	\$19,851,000
Interest and amortization <sup>(2)</sup>	1,465,000
Operation, maintenance, and replacement	<u>4,000</u>
Total annual charges	1,469,000

(1) No economic charges for interest during construction. Project components will be completed or operational at end of annual construction period.

(2) Interest and amortization factor or 100 years at 7 3/8 percent interest rate is 0.07381.



## BENEFITS

### GENERAL

Tangible benefits attributable to the project include flood damage reduction and related benefits including intensification, location, and advance bridge replacement. The benefits are summarized in the following paragraphs. Additional information concerning the development of these benefits is contained in appendix 5, Economic Base, Flood Damage and Benefit Analysis.

### FLOOD DAMAGE REDUCTION BENEFITS

In this economic analysis, annual flood damages have been computed for present conditions, defined as conditions anticipated in 1985 when it is assumed that proposed flood control improvements would be completed and in operation. The "present condition" damages include an allowance for interim economic growth applied to the computed base year 1980 damages. This economic analysis also recognized the future damage potential of existing floodplain development under future conditions and the extent to which various alternatives will reduce damages over an assumed 100-year economic life.

Estimated flood damages and flood related costs were obtained by studies conducted from November 1974 to January 1975 and from flood insurance studies and economic studies conducted in 1979 and 1980. Estimates of flood damages likely to be caused to commercial and public properties by inundation to various depths were obtained in interviews with businessmen and public officials. Residential damages were estimated by determining the approximate market value of each floodplain residence, the elevation of the ground, and the elevation of the first floor. Damages were then computed by using the standard depth-damage tables of the St. Paul District.

All flood damages are classified as urban and include residential, commercial, and public damages. Residential losses include physical damages to dwellings and their contents, damages to other personal property, and the cost of temporary quarters during flood emergencies. Losses to commercial establishments include physical damages to buildings, equipment, and

stocks of merchandise and losses caused by interruption of business, including wages not earned by employees and profits not earned by the firm. Losses to public properties include physical damages to streets, sidewalks, parks, schools and other public buildings, sewers, and sewage treatment facilities. Other public losses include additional costs incurred by local and State governments for emergency relief activities and overtime work by the police, firemen, and other public employees during floods.

The difference between flood damages with the project and without the project represents the flood damage reduction benefits attributable to the project. Over the 100-year economic life of the project at the 7 3/8-percent interest rate, the average annual flood control benefits are estimated to be \$2,178,700 for State Road Coulee.

#### RELATED BENEFITS

##### Location

The location benefit is the value of making floodplain land available for new uses by reducing flood hazards to activities which would use the floodplain only with protection. The plan permits residential and commercial use of the floodplain which would be used for agricultural purposes or remain vacant without the plan. Benefits were measured by estimating changes in the market value of the land. Benefits attributable to the State Road Coulee plan are \$18,600.

##### Intensification

The intensification benefit is the value of a plan to enable floodplain lands to be used for greater economic return. Development in the State Road Coulee area has been constructed in recent years and appears to be in very good physical condition. Existing structures should not require replacement before the year 2030. Therefore, no intensification benefits are claimed for State Road.

### Local Employment

Under terms of the Public Works and Economic Development Act of 1965, area redevelopment benefits derived from local employment during construction are also assignable to the project. However, no employment benefits are being claimed for the State Road Coulee project.

### Advance Bridge Replacement

Several of the existing bridges on State Road and Ebner Coulees would require replacement by either the years 1985 or 1990 or by the year 2000. The proposed channel modifications would obviate the need for bridge replacements at a later date without the project. Thus, in accordance with EM 1120-2-104, the proposed project can be credited with a benefit for this advance replacement. Advance bridge replacement benefits for State Road Coulee are \$32,700.

### Detour Costs

No detour benefits were included for the project. Detour cost savings would be inconsequential because of the short-term duration of flooding and the lack of significant detour problems during past floods.

## ECONOMIC JUSTIFICATION

Implementation of the selected plan for State Road Coulee would result in the economic benefits and benefit-cost ratio shown in the following table.

Average annual benefits	
Benefits	Amount
Flood control	\$2,178,700
Location	18,600
Saving of flood insurance costs	33,000
Flood proofing cost savings	9,200
Advance bridge replacement	32,700
Total	2,272,200
Benefit-cost ratio including future growth (100-year design)	
<u>Item</u>	
Average annual benefits	2,272,200
Average annual costs	1,469,000
Net benefits	803,200
Benefit-cost ratio	1.55

#### APPORTIONMENT OF COSTS AMONG INTERESTS

Since the project would serve only flood control, no allocation of costs among other purposes is required. On this basis the Federal Government would bear the costs of construction of the channel modification on State Road Coulee and related works, including a new railroad bridge over State Road Coulee. Local interests would furnish all lands and rights-of-way, construct all required new highway bridges, make necessary changes to roads, and utilities (except as otherwise warranted for special reasons), and maintain the project after completion. Relocation of utility lines through or under the proposed channel or diversion works considered to be an integral part of the project structures within the rights-of-way of the project and accordingly is a Federal cost. The distribution of costs between Federal and local interests is summarized as follows.

Distribution of costs			
Item	Federal	Non-Federal	Total
<u>First costs</u>			
Channel modification	\$18,546,700	\$1,304,200	\$19,850,000
<u>Annual costs</u>			
Interest and amortization	1,369,000	96,000	1,465,000
Maintenance	0	4,000	4,000
Total annual costs	1,369,000	100,000	1,469,000

## LOCAL COOPERATION

Prior to implementation of a project, non-Federal interests would be required to enter into a written agreement with the Secretary of the Army to furnish local cooperation requirements in compliance with Section 221 of Public Law 91-511. However, to proceed with the next step of further detailed project studies, non-Federal interests are required to furnish a letter of intent covering the local cooperation requirements and non-Federal responsibilities. As required by the project authorization and other applicable laws, before construction the local sponsor must agree to:

- a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project.
- b. Hold and save the United States free from damages due to the construction works.
- c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.
- d. Make all necessary relocations and alterations of buildings, utilities, highway bridges, sewers, and related facilities, except as otherwise provided.
- e. Prevent any encroachments which would reduce the flood-carrying capacity of either the improved channel on State Road Coulee or the diversion works for Ebner Coulee.
- f. Maintain the capacity of the existing Ebner Coulee channel immediately east of and parallel with the Chicago, Burlington and Quincy railroad track and preserve the existing outlet of Ebner Coulee at the storm sewer at Farnam Street.
- g. Provide guidance and leadership in preventing unwise future development of the floodplain by use of appropriate floodplain management techniques to reduce flood losses.

h. In the event of future development or improvements within the low-lying marsh beyond the downstream terminus of the Ebner Coulee diversion works, maintain an outlet through this area with sufficient capacity to carry the combined flows from Miller and Ebner Coulees.

i. At least annually inform affected interests that the channel improvements will not provide complete flood protection.

The estimated costs for local cooperation items a, c, and d based on October 1980 conditions and price levels for the recommended plan for State Road Coulee are shown in the following table.

Estimated costs for local cooperation items	
Item	Cost
	State Road Coulee
Lands and damages	\$116,300
Maintenance and operation (per year)	4,000
Relocations	1,187,900

Coordination has been maintained throughout this study with the designated representatives of the La Crosse area. The local units of government (the city of La Crosse and Shelby Township) were represented on the original citizens advisory committee appointed by La Crosse County, and the county representative attended most of the pre-1976 committee meetings. Through 1976, local cooperation for the authorized project was provided by the La Crosse County Board of Supervisors. However, county sponsorship is contingent upon the participation of the city of La Crosse and Shelby Township in a local cost sharing plan. Coordination with local interests during 1978-1980 was carried out primarily through the city of La Crosse. The city expressed strong interest in being the sole sponsor for the recommended project for State Road Coulee (and for Ebner Coulee, if possible). City officials believe that development

of a cost sharing plan that would be acceptable to the three local sponsoring groups previously mentioned could be a problem. To avoid this problem, the city of La Crosse has expressed its willingness to be the sole local sponsor.

Local groups provided new resolutions of support for the project in July and September 1978. These resolutions expressed renewed interest in project development and expressed the likelihood that local cooperation for the project would be forthcoming.

#### SUMMARY

This investigation provides a reevaluation and updating of the original planning studies for State Road and Ebner Coulees contained in the 3 November 1967 survey report. The survey report project recommendations authorized by Congress in the 1968 Flood Control Act provided for a flood damage reduction plan. Accordingly, this investigation has concentrated on meeting the flood damage reduction needs and has incorporated other feasible water and related land resource needs incidental to the best overall flood control plan.

Continued floodplain development has greatly increased the flood damage potential of the State Road and Ebner Coulee floodplains. The following table summarizes this sharp increase in development since 1951.

Floodplain development - State Road and Ebner Coulees	
Year	Residential units present <sup>(1)</sup>
1951	100
1970	725
1975	1,124
1980	1,808

(1) Single family and multiple dwelling.

The uncontrolled past development in La Crosse area floodplains appears to be under control with the new floodplain ordinance (1980) developed by the city of La Crosse. However, the health and safety of the floodplain residents remain threatened by the flash flood nature of runoff from the relatively small coulee drainage areas with steeply sloped rugged terrain in the upper portions. High velocity flows can occur upstream of Ward Avenue on State Road Coulee and 29th Street on Ebner Coulee but would be reduced greatly in the relatively flat terrain of the highly developed downstream areas where the occurrence of the 1-percent chance flood would pond to depths of 2 to 3 feet with maximum depths of up to 7 feet in some areas.

The duration of ponding would be about 6 hours in the State Road Coulee floodplain and up to about 16 hours in the Ebner Coulee floodplain. With an effective flood warning system, the maximum advance warning time for flood flows resulting from excess rainfall runoff would be limited to about 30 minutes along the Ebner Coulee floodplain and about 1 1/2 hours along the State Road-Ebner Coulee floodplain. Currently, State Road and Ebner Coulees have no flood warning system. Accordingly, a potential for loss of life exists in these floodplain areas as a result of the potential high velocity flows, depth of ponding, and the limited advance warning time.

To reduce the potential flood problems in State Road and Ebner Coulees, a comparative evaluation of 12 alternative solutions was made. The current evaluation uses previous studies and also provides:

- a. The incorporation of current water resources planning policies and criteria and development conditions of the State Road and Ebner Coulees floodplains.
- b. Additional plan formulation work recommended by reviewers of the 1967 survey report.



- 2

As a result of the current study, the best overall plan for State Road Coulee is considered to be channel modification consisting of rectangular and trapezoidal concrete, channels from the Hagen Road bridge to just downstream of the Burlington Northern railroad bridge, a distance of about 2.3 miles, and a concrete and riprap channel with outlet control between the railroad bridge and the Mississippi River marsh area. This lost distance is a little more than 0.2 mile. Modification of bridges and other public and private utilities would be required.

For Ebner Coulee, the best overall plan is considered to be channel modification and diversion of flows northward to Miller Coulee and thence to the La Crosse River floodplain. The channel modifications would consist of a rectangular concrete channel along the existing channel for a distance of 0.4 mile east of the Burlington Northern railroad tracks. The diversion consists of two underground concrete pipes 0.9 mile in length to convey flows to Miller Coulee, with the coulee enlarged for 0.3 mile to a marsh adjacent to the La Crosse River. Modifications are also required to bridges and other public and private utilities. However, this plan is no longer economically feasible and is not recommended for construction.

The plan for State Road Coulee is essentially the same as the survey report recommendations except the degree of protection has been increased to accommodate the 1-percent chance flood as opposed to protection from the 2-percent chance flood. Other modifications to the authorized plan for State Road Coulee include: modifications to the lower end of the proposed project to meet environmental objections and elimination of several proposed bridges that are already built (Ward Avenue) or elimination of a bridge for an at-grade road crossing (farm bridge at station 19+65).

## RECOMMENDATIONS

I recommend that the United States undertake the construction of channel improvement on State Road Coulee in the interest of flood control, generally in accordance with the plans in this report and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at a total estimated Federal first cost of \$18,546,700, non-Federal first cost of \$1,304,200, and non-Federal annual maintenance, operation, and replacement costs of \$4,000, provided that prior to construction, and in accordance with section 221 of the Flood Control Act of 1970, local interests will enter into a written agreement with the the Secretary of the Army that they comply with the terms of local cooperation listed on page 130.

I further recommend that the diversion works originally authorized for Ebner Coulee not be constructed at this time because these works lack economic feasibility. I recommend that the Ebner Coulee project be placed in an inactive status.

WILLIAM W. BADGER  
Colonel, Corps of Engineers  
District Engineer

2.2  
DRAFT

ENVIRONMENTAL IMPACT STATEMENT

Proposed Plan for Flood Control  
State Road Coulee, La Crosse County, Wisconsin

U.S. Army Engineer District, St. Paul  
Corps of Engineers  
St. Paul, Minnesota

April 1981

DRAFT  
ENVIRONMENTAL IMPACT STATEMENT  
Proposed Plan for Flood Control, State Road Coulee  
La Crosse County, Wisconsin

The responsible lead agency is the U.S. Army Engineer District, St. Paul.

Abstract: The State Road Coulee is located in Shelby Township and the city of La Crosse, in La Crosse County, Wisconsin. The St. Paul District has investigated public concerns of the State Road Coulee study area related to flood problems caused from high rates of runoff from the rugged terrain in the upper parts of the watershed. Of the twelve plans initially considered, six were selected for detailed study. Non-structural alternatives considered included Plan 3, flood proofing; Plan 4, flood insurance; Plan 5, floodplain regulation; and Plan 6, a combination of floodplain evacuation, flood proofing, and floodplain regulation. Structural alternatives considered were Plan 9, levee and floodway construction, and Plan 10, channel modification, which was designated as the National Economic Development Plan. Plan 10, lower terminus variation e-7, was selected as the recommended plan on the basis of its responsiveness to evaluation criteria and its satisfaction of planning objectives.

SEND YOUR COMMENTS TO  
THE DISTRICT ENGINEER BY

If you would like further information  
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## 1.00 SUMMARY

### MAJOR CONCLUSIONS AND FINDINGS

1.01 The selected plan must satisfy specific objectives of the study area and should show positive contribution to the national objectives of National Economic Development and Environmental Quality. To achieve a balanced plan which reflects society's dual concern for improving national economic efficiency while maintaining and enhancing the natural environment, study participants sought to develop one plan emphasizing the Environmental Quality objective and another plan emphasizing the National Economic Development objective.

1.02 The National Economic Development (NED) plan addresses the planning objectives while maximizing the net economic benefits. The channel modification alternative (Plan 10e-7) maximizes net average annual benefits and constitutes the National Economic Development plan for State Road Coulee. It has a benefit/cost ratio of 1.55. (See paragraph 3.09, p. EIS-11.)

1.03 After the channel modification plan (Plan 10e-5) was selected as the recommended plan in 1976, the Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service proposed elimination of the 700-foot-long, 10-foot-wide (bottom) pilot channel. This proposal was presented at the 11 April 1980 environmental scoping meeting held at La Crosse. In addition, several variations in the lower terminus of State Road Coulee were considered for the channel modification plan. To simplify the description, the lower terminus variations are not considered alternative plans, but are shown as variations of the recommended plan (10e-7) for State Road Coulee.

1.04 Environmental Quality (EQ) measures are a means taken to preserve, enhance, or restore environmental values at a level greater than the "without" project condition. All flood control alternatives either do not affect environmental values, or degrade or destroy some natural, cultural, or environmental values. None of the flood control alternatives considered makes significant net beneficial contributions to the EQ account. Therefore, a specific Environmental Quality Plan was not developed. Instead, an environmentally least damaging plan was developed in cooperation with the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources. This plan is Plan 10e-7, channel modification with a riprap outlet control structure terminating at Station 9+00, which would eliminate the need for an earth pilot channel in the floodplain, and would significantly reduce impacts on the Mississippi River floodplain.

1.05 The environmental evaluation conducted for this study concludes that the impacts of various alternative flood control solutions are generally small or tolerable in the State Road Coulee area that is subject to major flood damages. The channel and adjacent floodplain have previously been altered by urban development and measures to provide drainage and control flooding. Most of the impacts of the alternatives considered involved the developed areas downstream of the Hagen Road bridge and the wooded Mississippi River floodplain area at the mouth of State Road Coulee. In the former area, the mammal and resident bird populations have been previously affected by existing development, and the biota now inhabiting the State Road Coulee channel is of minimal value to man. In addition, the development of this area has not provided any known cultural or historical attributes. The floodplain area is moderately valuable wildlife habitat. Impacts on resources in this area would be more significant than those on upstream areas.

1.06 The only known archaeological sites in the general area lie just south of the natural channel of the lower portion of State Road Coulee. Preliminary investigations to date have not indicated that the Overhead archeological site (a National Register of Historic Places property) does not extend to the north side of State Road Coulee in the proposed project area; however, a separate small site has been identified in this area. Most alternative solutions considered further are not expected to significantly impact upon any cultural or historical attributes in the general La Crosse area.

1.07 The selection of a plan for State Road Coulee involved the identification and development of the best possible combination of National Economic Development benefits and Environmental Quality benefits. The identification of an NED plan for State Road Coulee in the previous paragraphs of this section ranked the channel modification alternative (Plan 10e-7) highest among considered solutions in the NED account. For the EQ account, this plan ranks somewhat lower than the alternative which combines flood insurance and floodplain regulation.

1.08 The recommended channel modification plan (Plan 10e-7) is a more practical plan in terms of local acceptance and economic feasibility and thus is considered to be a better plan. The other alternative solutions that generally meet the specific planning objectives will not provide a better mix of NED and EQ benefits since they rank lower in both of the national objectives. Therefore, the channel modification alternative is selected as the plan which would best satisfy the specific and national planning objectives.

#### AREAS OF CONTROVERSY

1.09 There are no areas of major controversy concerning the selected plan of the State Road Coulee flood control project. Study participants expressed concern over effects on fish and wildlife resources of the Mississippi River floodplain and the Upper Mississippi River National Wild Life and Fish Refuge, threatened and endangered species, riparian habitat along the lower reaches of Pammel Creek, and cultural resources.

#### UNRESOLVED ISSUES

1.10 The identification of environmentally acceptable disposal sites for excavated material and the feasibility of implementing the EQ element of the selected plan are the only remaining significant unresolved issues associated with the proposed project.

#### RELATIONSHIP TO ENVIRONMENTAL PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS

1.11 Table 1 describes the relationship to applicable environmental regulations of the six feasible alternatives that were developed in detail (see section 3.00 for a discussion of all the alternatives considered).



**Table 1**  
**Relationships of Plans to**  
**Environmental Requirements**

<b>Federal Statutes</b>	<b>Plan 3</b>	<b>Plan 4</b>	<b>Plan 5</b>	<b>Plan 6</b>	<b>Plan 9</b>	<b>Plan 10</b>	<b>Plan 10a-7</b>
Archeological and Historic Preservation Act, as amended, 16 U.S.C. 469 et seq.	N/A	N/A	N/A	Partial	Full	Partial	Partial
Clean Air Act, as amended, 42 U.S.C. 7401, et seq.	Full	Full	Full	Full	Full	Full	Full
Clean Water Act, as amended (Federal Water Pollution Control Act), 33 U.S.C. 1251, et seq.	Full	Full	Full	Full	Partial	Partial	Partial
Coastal Zone Management Act, as amended, 16 U.S.C. 451, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, et seq.	Full	Full	Full	Full	Partial	Partial	Partial
Estuary Protection Act, 16 U.S.C. 1221, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1(12), et seq.	N/A	N/A	N/A	N/A	Full	Full	Full
Fish and Wildlife Coordination Act, as amended, U.S.C. 661, et seq.	Partial	Partial	Partial	Partial	Partial	Partial	Partial
Land and Water Conservation Fund Act, as amended, 16 U.S.C. 4601-4601-11, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Marine Protection, Research and Sanctuaries Act, 22 U.S.C. 1401 et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321, et seq.	Full	Full	Full	Full	Partial	Partial	Partial
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470a, et seq.	N/A	N/A	N/A	Partial	Full	Partial	Partial
Rivers and Harbors Act, 33 U.S.C. 401 et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001 et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wild and Scenic Rivers Act; as amended, 16 U.S.C. 1001, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Executive Orders, Memoranda</b>							
Floodplain Management (EO 11988)	Full	Full	Full	Full	Non compliance	Partial	Partial
Protection of Wetlands (EO 11990)	Full	Full	Full	Full	Non compliance	Partial	Partial
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Analysis of Impacts on Prime and Unique Farmlands, CEQ Memorandum 30 August 1976	Full	Full	Full	Full	Full	Full	Full
State and Local Policies	Full	Full	Full	Full	Full	Full	Full
Land Use Plans	Non compliance	Full	Full	Non compliance	Full	Full	Full
<b>Required Federal Entitlements</b>							
U.S. Fish and Wildlife Service Special Use Permit	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NOTES: The compliance categories used in this table were assigned based on the following definitions:

- a. Full compliance - All requirements of the statute, E.O., or other policy and related regulations have been met.
- b. Partial compliance - Some requirements of the statute, E.O., or other policy and related regulations remain to be met.
- c. Noncompliance - None of the requirements of the statute, E.O., or other policy related regulations have been met.
- d. Not Applicable (N/A)- statute, E.O., or other policy not applicable.

## 2.00 NEED FOR AND OBJECTIVES OF ACTION

### STUDY AUTHORITY

2.01 The project for flood damage reduction recommended by the Chief of Engineers in House Document No. 368, 90th Congress, 2nd Session, provides for channel modifications along the lower reach of State Road Coulee. The project was authorized by the Flood Control Act approved 13 August 1968 (Public Law 90-483).

### PUBLIC CONCERNS

2.02 The major public concern expressed during the planning process was the need for flood damage reduction on State Road and Ebner Coulees. Under current conditions, damage to residential property occurs when flows below Hagan Bridge on State Road Coulee exceed 1,100 cubic feet per second (cfs) (about a 7-year flood) and when flows of about 130 cfs (about 6-year flood) occur at Farnam Street on Ebner Coulee. Periodic flooding also occurs along lower reaches of State Road Coulee where runoff is trapped behind present dikes. About 94 percent of the monetary damages from flooding occur to residential properties, 5 percent to commercial facilities, and 1 percent to public facilities.

2.03 Concern was also expressed about land resources management, unplanned development practices, urban stormwater runoff and drainage problems, development of recreation facilities, loss of fish and wildlife habitat, sedimentation impacts, public health and safety, water quality, disposal of excavated materials, and cultural resources. All of these concerns were taken into consideration in the formulation and selection of flood control alternatives. A detailed discussion of public involvement is presented in Section 6.00 of this statement.

### PLANNING OBJECTIVES

2.04 Planning objectives for the Phase I study for State Road Coulee were identified from the resource management needs and public concerns associated with plan formulation for flood damage reduction on State Road Coulee. These planning objectives include:

1. The plan must provide significant flood damage reduction or compensation.
2. The plan must minimize lands required for flood control and relocations of existing residences. Because developable land is limited by topography in the La Crosse area, land needed for flood control purposes would further affect future development for residential and commercial use.
3. The plan must not be aesthetically disruptive.
4. The plan must be consistent with the overall land use planning for the La Crosse area.
5. The plan must incorporate measures to minimize potential safety hazards associated with flood events.
6. The plan must minimize adverse impacts on fish and wildlife habitat, to the extent possible, including potential secondary impacts on the Upper Mississippi Wild Life and Fish Refuge.
7. The plan must incorporate measures which will avoid or minimize impacts on the Overhead cultural resources site south of lower Pammel Creek.

### 3.00 ALTERNATIVES

3.01 Twelve plans were considered during Phase I planning. Six of these plans were considered in detail and carried into Stage 3 planning. A brief explanation of the six plans eliminated from further study and the reasons for their elimination are given below. More detailed explanations of the no action alternative and the six alternatives considered in detail follow the plans eliminated from further study.

#### ALTERNATIVES ELIMINATED FROM FURTHER STUDY

3.02 Plans 1 (flood warning and emergency protection), 2 (permanent floodplain evacuation), 7 (upstream land treatment), 8 (upstream reservoir storage), 11 (reservoir storage and channel modification), and 12 (channel diversion and modification) were eliminated from further study because they did not meet the study planning objectives, were socially unacceptable, or were not feasible economically. For a detailed description of these eliminated plans, see the alternatives discussion in the General Design Memorandum, pages 30-63.

#### WITHOUT CONDITIONS (NO ACTION)

3.03 Maintaining existing conditions means taking no action to alleviate potential flood problems in State Road Coulee except for adopting floodplain zoning ordinances to comply with State floodplain regulations. This means the people and existing structures in the flood-prone areas would be subjected to periodic flooding which would present hazards to the health, safety, and social well-being of those concerned. Potential annual economic losses from the flooding are estimated at \$2.2 million.

#### PLANS CONSIDERED IN DETAIL

3.04 Plan 3 calls for flood proofing of all flood-prone buildings. Under this plan, structures would be protected, but protection would not be offered against damage to streets and residential lots, access problems during high water, potential safety problems, or minor basement seepage. Implementation would be a joint Federal and local effort with average annual costs of \$207,000 being incurred by the Federal Government and \$78,000 being incurred by the local government (values are 1976 dollars). The benefit/cost ratio is 0.92.

3.05 Plan 4 calls for flood insurance whereby the Federal Emergency Management Agency (FEMA) provides insurance against flood damages to residences, businesses, farmsteads, and other buildings and their contents, up to prescribed limits. It does not reduce flood damages, but simply spreads the cost of the damages over a wider segment of the population. FEMA would incur estimated annual costs of \$3,200,000, with the non-Federal costs of about \$400,000 (1980 dollars). The benefit/cost ratio is 0.4.

3.06 Plan 5 calls for reduction of flood damages through use of legal tools by the local government to control the extent and type of future development in the floodplain. Implementation would be a local responsibility with undetermined average annual costs.

3.07 Plan 6 is a combination of Plans 4 and 5, coupled with evacuation of some parts of the floodplain. Implementation would be a joint Federal-local effort that would involve relocation of 58 homes and flood proofing of an additional 343 homes. Because this plan does not alter flood flows, damage to streets and residential lots would still occur, access to homes would be limited, and potential safety problems would remain. The benefit/cost ratio is 1.01.

3.08 Plan 9 consists of a floodway system formed primarily by levees along both sides of State Road Coulee with an earth pilot channel in the downstream reaches to guide flows through the floodplain forest. This plan requires replacement of several bridges, the acquisition of 120 acres of land, and relocation of 23 residences and one business. Implementation would be a Federal responsibility with some cost-sharing by the local sponsor. Average annual costs for the Federal Government would be approximately \$188,000, with the local sponsor supplying the remaining \$72,000 (1976 dollars). The benefit/cost ratio is 1.26.

3.09 Plan 10 calls for modification of the existing channel to increase hydraulic efficiency, so that waters are quickly removed from the area without flooding. Five different types of channel modifications were considered. These include (a) earth-lined channels, (b) riprap-lined channels, (c) concrete-lined channels, (d) concrete-lined plus enclosed channels, and (e) concrete-lined channels plus riprap-lined channels (this type of modification has 7 associated subparts which designate 7 different alignments of the channel in the downstream reaches; see GDM, pages 45-55).

3.10 Implementation of Plan 10 would be a Federal responsibility with cost-sharing by the local sponsor. Annual average costs range from \$1,335,000 to \$2,233,000 according to the type of channel modification chosen. Benefit/cost ratios range from 0.38 to 1.62.

3.11 Plan 10e-7 is the NED and least environmentally damaging plan, and is therefore designated the selected plan. The selected type of channel modification is type "e", concrete-lined channels plus riprap-lined channels. The seventh subpart to this type of channel modification was selected. The selected plan may therefore be summarized as Plan 10e-7, which includes concrete and riprap channel modifications, and eliminates the earth-lined pilot channel. The benefit/cost ratio is 1.55.

3.12 A potential Environmental Quality (EQ) element of the recommended plan (10e-7) is being investigated which would contribute significant benefits to the EQ account. This element would consist of acquisition and preservation as open space of approximately 42 acres of property west of the Burlington Northern railroad tracks and south of Pammel Creek. This would preserve and protect the Overhead archeological site from future development and provide a buffer area adjacent to the Upper Mississippi River National Wild Life and Fish Refuge because access could be restricted by removal of the existing bridge across Pammel Creek at Station 19+65 (see Plate 6). This element of Plan 10e-7 could be cost shared at 75 percent Federal and 25 percent local cost under the fish and wildlife enhancement funding guidelines.

#### COMPARATIVE IMPACTS OF ALTERNATIVES

3.13 Table 2 presents the comparative impacts of the various alternatives.

Table 2

## Comparative Impacts of Alternatives

Alternatives	Wetlands Lower Pammel Creek	Upper Mississippi Fish and Wildlife Refuge	Overhead Archaeological Site	Endangered Species	Water Quality
Without Condition (No Action)	No impact.	No impact.	Anticipated continued development of South La Crosse will eventually result in destruction of the site.	No change in habitat is anticipated.	No impact.
Plan 3	No impact.	No impact.	No impact.	No impact.	No impact.
Plan 4	No impact.	No impact.	No impact.	No impact.	No impact.
Plan 5	No impact.	No impact.	May inhibit or slow destructive development.	No impact.	No impact.
Plan 6	No impact.	No impact.	Floodplain regulation may inhibit or slow destructive development. Minimal impact from floodplain evacuation or flood proofing.	No impact.	No impact.
Plan 9, 10a, 10b, 10c, 10d, 10e-1	Removal of 2-8 acres of floodplain vegetation. Possible damage to northern pike spawning habitat.	Could aggravate trespass problems. Temporary turbidity and bed load shifting in refuge receiving waters affecting aquatic habitat. Some floodplain habitat losses.	See discussion in Environmental Effects, section 5.00.	Possible removal of bald eagle roosting trees. Possible sedimentation of potential Higgins' eye mussel habitat.	Increase in turbidity and sediment load of the discharge water during construction. Minor increases in turbidity and a shifting of sediment load in receiving waters during high water events on Pammel Creek which should be reduced as channel becomes stabilized below plan outlet.
Plan 10e-2	Removal of 2-8 acres floodplain & possible damage to some northern pike spawning habitat. Change in riparian species composition in former channel.	Same as 9.	Loss of cultural data due to construction of channel.	Same as 9.	Same as 9.
Plan 10e-3	Same as 9.	Same as 9.	No impact.	Same as 9.	Same as 9.
Plan 10e-5	Same as 9.	Same as 9.	No impact.	Same as 9.	Same as 9.
Plan 10e-6	Less than 1 acre of floodplain vegetation would be removed. Change in riparian species composition in former channel. Channel configuration through receiving wetlands would likely change.	No impact.	No impact.	No impact.	Same as 9.
Plan 10e-7	Same as 10e-6.	No impact.	No impact.	No impact.	Same as 9.
Plan 10e-7 with EQ element	Same as 10e-6.	Provides adjacent buffer zone to refuge. Vehicular access could be restricted across the area, reducing impacts from illegal activities.	would protect site from future development; would preserve educational and scientific values of cultural resources at site.	No impact.	Same as 9.

#### 4.00 AFFECTED ENVIRONMENT

##### ENVIRONMENTAL CONDITIONS

4.01 The State Road Coulee watershed (covering approximately 6 square miles) begins in the bluffs overlooking the Mississippi River east of the city of La Crosse in La Crosse County, Wisconsin. Pammel Creek, which drains the watershed, flows west past the steep terrain of the bluffs onto a gently sloping terrace, then turns south before it converges with the Mississippi River backwaters of Pool 8 approximately 5 miles from its origin. Most of the watershed is located in Shelby Township with the remainder in the city of La Crosse.

4.02 La Crosse and Shelby Township contain a 1980 population of 53,375. The area has a healthy economic climate characterized by a diversity of economic activities: industrial, commercial, and governmental goods and services (see Appendix 5 of the GDM). Development is constrained by the limited availability of suitable lands, because La Crosse lies on a narrow terrace between the Mississippi River and the bluffs. Land values are therefore high. Within the State Road Coulee area, the primary land use is residential, and the developmental trend is toward expansion of residential properties. Extensive development of the State Road Coulee watershed and floodplain has contributed to flood damages in the coulee floodplain.

4.03 Wildlife habitat in the upper portions of State Road Coulee is not abundant due to the extensive urban development and alteration of coulee channels for drainage and flood control. Downstream of the U.S. Highway 14/61 underpass, where the creek is called Pammel Creek, it is less altered and flows to the Mississippi River through a relatively undeveloped floodplain forest. This floodplain forest provides habitat for a diverse array of wildlife species.

##### SIGNIFICANT RESOURCES

###### Wetlands

4.04 The stream and associated floodplain forest and wetlands of lower Pammel Creek from the U.S. 14/61 overpass to the creek's confluence with the Mississippi River constitute moderate to high value fish and wildlife habitat. Here the creek is less altered and flows to the Mississippi River through a relatively undeveloped floodplain forest consisting of Wetland Types 1, 2, 3, and 4 (USDI, Fish and Wildlife Service, Wetlands of the United States, Circular 39). According to the new Classification of Wetlands and Deepwater Habitats of the United States, the wetlands are of the Riverine and Palustrine Systems and include the following classes: Unconsolidated Bottom, Aquatic Bed, Emergent Wetland, and Forested Wetland.

4.05 The floodplain forest community provides habitat for a diversity of wildlife, including white-tailed deer (Odocoileus virginianus), muskrats (Ondatra zibetnica), mink (Mustela vison), great blue herons (Ardea herodias), black-crowned night herons (Nycticorax nycticorax), green herons (Butorides striatus), great egrets (Casmerodius albus), rails, woodducks (Aix sponsa), songbirds, raptors, cottontails (Sylvilagus floridanus), foxes, skunks (Mephitis mephitis), raccoons (Procyon lotor), fox squirrels (Sciurus niger), gray squirrels (Sciurus carolinensis), reptiles and amphibians. The confluence of the creek and the Mississippi River provides excellent habitat for many species of waterfowl and marsh birds. An

extensive reed canary grass (Phalaris arundinacea) marsh in this area has been identified as valuable northern pike (Esox lucius) spawning habitat. The U.S. Fish and Wildlife Service considers this lowland habitat significant because it provides wildlife habitat contiguous to the Upper Mississippi River National Wild Life and Fish Refuge. Although development affecting this resource will be limited in the future because of its floodplain location, the pressure of human activities in this area will increase as urbanization continues in adjacent areas.

#### Upper Mississippi River National Wild Life and Fish Refuge

4.06 A portion of the U.S. Fish and Wildlife Service Upper Mississippi River National Wild Life and Fish Refuge is located in the Mississippi River bottomlands south of the terminus of the proposed State Road Coulee project. The refuge is contiguous to the lower Pammel Creek wetland and floodplain forest discussed above, and the confluence of Pammel Creek and the Mississippi River is located essentially within the refuge. The biological communities of the refuge in the study area are similar to those of lower Pammel Creek; the two areas generally share the same plant and animal species components. However, the refuge here does not have stream riparian habitat like lower Pammel Creek, has more open water areas and deeper marsh areas, and is managed for northern pike spawning and general habitat for marsh species and waterbirds. Refuge trespass problems, including such things as illegal woodcutting, poaching, and vandalism, have been increasing in recent years and will likely continue as the local population increases and urbanization presses closer to refuge boundaries.

#### Overhead Archeological Site

4.07 The Overhead archeological site (47 Lc 20), a property listed on the National Register of Historic Places, was first reported in 1971. This site is located on the first terrace of the Mississippi River south of La Crosse. It presently overlooks a large backwater area to the west into which Pammel Creek empties. The site was first excavated by Stoltman (1973) in 1971 as the result of the development of a new subdivision. Construction was never undertaken, and the next survey and testing of the site was done in conjunction with a Wisconsin highway project (Penman, 1978). This survey provided the basis for establishing the boundaries of the National Register site. In 1980, Gallagher completed additional work at the site under a Corps of Engineers contract and a Historic Preservation Grant. This work was to determine the extent of the Overhead site within the project area. Testing at the Overhead site was concentrated within a 100-foot corridor along Pammel Creek. Test units were dug at 10-meter intervals along the creek and bank profiles were cut every 50 meters. No prehistoric materials were encountered in any of these units. Gallagher (1980:12) concludes that "the northwestern boundary of the Overhead Site can be moved eastward from its presently defined position." Additional work by Gallagher under his Historic Preservation Grant should more accurately establish the boundaries of the Overhead site.

4.08 Data recovered from this site by Stoltman (1973) included artifactual materials, cultural features, and faunal remains. Four hearth and storage/refuse pit features were found at this site. In addition, one oval, single port structure was reported. This structure was one of the first Orr Phase Oneota dwelling

structures which has been reported. Artifacts located in the features and disturbed site areas included 256 shell-tempered sherds, representing at least 9 ceramic vessels, 120 lithic artifacts, including bifaces, cores, and worked and unworked flakes; and one bison scapula hoe found in a feature. Large quantities of burned and unburned mammal and fish bone were also found in the features.

4.09 Penman's later survey (1978) reported large quantities of lithic material in the southern portion of the site as well as grit-tempered and marked sherds and shell-tempered sherds.

4.10 The Overhead site consists of two components: an Oneota occupation (ca. AD 1420-AD 1430) and an earlier Woodland occupation (ca. 200 BC-AD 1200). The artifacts, well preserved organic remains, and cultural features recovered from this site have already answered a number of questions regarding Oneota culture history and human ecology. The discovery of this site has further substantiated Orr Phase occupation in western Wisconsin during the late prehistoric period. The apparent late prehistoric occupation of western Wisconsin by Orr Phase groups may provide significant information on population dynamics and movement for a culture which has a fairly long tradition. Comparisons of data derived from the Overhead site with earlier Oneota sites and later protohistoric Oneota sites in Wisconsin, Iowa, and Minnesota should reveal much information on the changes which took place in Oneota settlement patterns. A single-post, wigwam structure excavated at the Overhead site was one of the first Orr Phase structures to be reported. Another important aspect of this site is its late prehistoric but pre-European contact occupation. The site can therefore serve as a good example of a pre-contact Oneota site, providing valuable information on the influence of European contact when compared with protohistoric Oneota sites.

4.11 The Oneota component at the Overhead site can also provide a fairly detailed view of Oneota food procurement and resource utilization due to the well preserved nature of the organic remains recovered from the site. A Woodland component as well as the Oneota component is present in the southern and western portions of the site. The particular Woodland manifestation at this site has not been identified as yet; however, based upon the density and amount of cultural materials noted and the tendency for large Woodland habitation sites in the Upper Mississippi Valley to contain sub-plowzone features, it is likely that undisturbed deposits exist at this site. These deposits have the potential for providing significant data on Woodland culture history and cultural ecology.

#### Endangered Species

4.12 To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, a request for information on any endangered species in the area was sent to the U.S. Fish and Wildlife Service. As of 19 June 1980, they listed the bald eagle (Haliaeetus leucocephalus), a threatened species, and the Higgins' eye pearly mussel (Lampsilis higginsii), an endangered species, as two species which may be present in the project area. The concern was raised that bald eagles may winter in the project area, using large trees near open water for hunting perches, loafing, and roost sites. The Higgins' eye pearly mussel occurs in the Pool 8 of the Mississippi River, thereby necessitating assessment of potential project impacts on this species.



4.13 In addition to the federally-listed endangered or threatened species discussed above, the following Wisconsin State endangered or threatened species may possibly occur in the project area: osprey (Pandion haliaetus), double-crested cormorant (Phalacrocorax auritus), great egret (Casmerodius albus), Cooper's hawk (Accipiter cooperi), red-shouldered hawk (Buteo lineatus), and the massasauga rattlesnake (Sistrurus datenatus).

#### Water Quality

4.14 Several public agencies expressed a concern that a channelization plan might increase sedimentation at and below the confluence of Pammel Creek with the Mississippi River. This would have an adverse effect on the northern pike spawning habitat in the area. There were also concerns that other water quality parameters, such as temperature and dissolved oxygen, would be adversely affected, reducing the aquatic habitat values of Pammel Creek.

4.15 In the past, Pammel Creek has had high levels of coliform bacteria which are indicators of fecal contamination and which can be associated with disease-producing agents. Point sources also contribute to organic loading in Pammel Creek. These problems have largely been rectified in recent years because of sewer installation in the watershed but non-point sources still contribute contaminated runoff.

4.16 A sedimentation problem still exists because of erosion in the watershed and bank scouring during high flows. Generally, water quality parameters of Pammel Creek are typical of the groundwater source streams in the Wisconsin driftless area.

## 5.00 ENVIRONMENTAL EFFECTS

5.01 This chapter discusses significant impacts on five environmental resource categories identified in section 4.00: wetlands, the Upper Mississippi National Wild Life and Fish Refuge, cultural resources, endangered species, and water quality. The most significant impacts result from the channel excavations and alignments in Plans 9 and 10. In addition to these significant impacts, impacts on additional elements are discussed at the end of this section in accordance with the requirements of Section 122, Public Law 91-611. These include visual impacts; air quality; temporary construction impacts; loss of various types of vegetation, fish, and wildlife; and social effects. The proposed fill activities have been evaluated in accordance with the requirements of Section 404 of the Clean Water Act of 1977. The evaluation is included as Exhibit 1 of this report.

### SIGNIFICANT IMPACTS

#### Wetlands

5.02 The No Action Plan; Plan 3, flood proofing; Plan 4, flood insurance; Plan 5, floodplain regulation; and Plan 6, a combination of floodplain evacuation, flood proofing, and floodplain regulation would have no impact on this resource except that the floodplain regulation aspects of the No Action Plan and Plans 5 and 6 would help protect the resource from development.

5.03 Plan 9, levee and floodway construction, would eliminate 9 acres of existing Pammel Creek aquatic and riparian habitat, and Mississippi River floodplain. Although vegetation could be established on the new landward levee slopes, the former biotic community would not be reestablished and a significant decrease in both plant and animal species diversity and abundance could be expected.

5.04 Both Plans 9 and 10 (with a full or pilot channel through the floodplain), by concentrating flows in one channel through the adjacent floodplain reed canary-grass marsh, could eliminate a beneficial replenishment of overflow water throughout the marsh. This elimination could have an adverse effect on the aquatic ecosystem by reducing the levels of incoming nutrients and by influencing a trend toward a drier site during the summer months when Mississippi River high waters would not be available for maintenance of water levels.

5.05 The various alternative alignments for the terminal reach of Plan 10 would affect this resource in varying degrees, depending on the routes of the alignments. The most detrimental alignment (e-3) through the existing channel would eliminate the riparian habitat in this reach of lower Pammel Creek. The other alternative alignments would avoid this reach but would impact about 2 to 8 acres of floodplain forest and marsh habitat. The recommended plan (10e-7) would affect less than 1 acre of floodplain forest and marsh habitat.

5.06 The increased hydraulic efficiency of the Plan 9 and 10 channels could resuspend and displace sediments further downstream of the ends of the channels. Northern pike spawning habitat could be diminished by this effect. The recommended plan would impact the pike spawning habitat identified below the confluence of the creek with the Mississippi River to a much smaller degree than Plans 9 and 10.

## The Upper Mississippi River National Wild Life and Fish Refuge

5.07 None of the nonstructural plans would affect the refuge. Plan 9, levee construction, and Plan 10, channel modification (including the various alternatives of 10a, b, c, d, and e-1 through e-5, with either full or pilot channels through the Mississippi River floodplain), would have the following effects on the refuge.

5.08 Concentration of flows in one channel would increase the velocity of flows released at the terminus of the channel which would flow almost directly onto the refuge lands. The aquatic ecosystem in this area could be disturbed and modified by the change in the creek's hydraulic pattern. During times of high runoff, sediments could be displaced downstream into the receiving waters of the refuge. Benthic organisms could be displaced or covered by sediments. Substrate suitable for pike spawning could be disturbed, lost, or covered. Until the area becomes stabilized, the aquatic ecosystem below the terminus of any plan extending into the floodplain will suffer decreased species diversity, abundance, and productivity.

5.09 Plan 9 and the terminal alignment variations of Plan 10 that extend onto the Mississippi River floodplain toward the refuge could enhance access to the refuge and aggravate the existing trespass problems. If adjacent maintenance roads are included in these plans, this would intensify the effect even more.

5.10 Since the recommended plan (10e-7) does not include a pilot channel to the river it would have a minor effect on the ecological values of the refuge and not be likely to enhance unwanted access to the refuge to a significant degree.

## Overhead Archaeological Site and Other Cultural Resources

5.11 The Overhead site is a property which has been listed on the National Register of Historic Places. In the past, this site was probably larger than that recorded within the National Register site boundaries. Portions of the site have probably been destroyed by the Chicago, Burlington, and Quincy Railroad lines which run along the eastern portion of the site. Today, this section of track defines the eastern boundary of the site. Although elevation decreases, the site may also have extended eastward to U.S. Highways 14 and 61. At the northern end of the site, disturbance from the highway is unquestionable. Here again a modern transportation route serves as part of the site boundary.

5.12 The site is currently under cultivation and outside of this, the only other impacts upon the site within its present boundaries are from the farmhouse and outbuildings located within the northern portion of the site, and the disturbance from the planned development of a new subdivision.

5.13 The No Action Plan will ultimately have an adverse impact upon this site. The site was first reported in 1971 when it was discovered during the construction of a new subdivision. Excavation was undertaken in this northern portion by Stoltman (1973), where grading had removed up to 1 foot

of topsoil. Although this subdivision was not constructed, it seems apparent that development in the south part of La Crosse will ultimately have an adverse impact upon the site if present conditions are not altered. Over the past decade, suburban development has taken place just north of Pammel Creek and small business development has moved southward on U.S. Highways 14 and 61. (See the land resource management section of the General Design Memorandum.)

5.14 Plan 3, flood proofing, would have little impact upon the Overhead site. The only structure which would require flood proofing and would also have an impact upon the site would be the farmhouse in the northern portion of the site. The flood proofing methods discussed in the main report would probably have little impact on the Overhead site since the farmyard probably has been severely disturbed.

5.15 However, this alternative, if undertaken at this location, may result in adverse impacts to a historic archeological site reported by Gallagher (1980). Shovel testing near the farmhouse yielded concentrations of brick, stone rubble, and cinders. These remains correspond to the location of a structure mapped on an 1874 La Crosse County map produced by H.I. Bliss, a civil engineer and surveyor. Additional testing at this site will be required to determine the exact nature and date of the remains recovered by Gallagher.

5.16 Plan 4, the flood insurance plan, would have no impact upon the Overhead site. However, a combination of this plan with Plan 5, floodplain regulation, may have a small beneficial effect upon the site. Floodplain regulation could slow or inhibit the type of development which has been evident to the north. Floodplain regulation could also limit use of this area to present agricultural practices or to its use as open or green space. These types of uses, especially the latter, would be consistent with present historic preservation efforts.

5.17 Plan 6 is a combination of flood proofing, floodplain regulation, and floodplain evacuation. This alternative would have the same impacts upon the Overhead site as Plan 5 above with the addition of minimal impacts for floodplain evacuation and flood proofing. Since the yard surrounding the farmhouse has been very disturbed, removal of this house and outbuildings or flood proofing of the house would probably have minimal impact upon the Overhead site. The significance of the farmhouse has not been assessed; however, as Gallagher (1980:7) notes, "...it is unlikely that the present farm house is the same structure that was plotted in 1874."

5.18 No assessment has yet been made of the significance of other structures within the project area which may be evacuated or flood proofed. If this alternative were selected, evaluation would be undertaken as the affected structures were identified.

5.19 Plan 9, the levee and floodway plan, would not affect the Overhead site based upon the results of the survey conducted by Gallagher, even though this alternative does impinge upon the site as presently defined. This alternative would also require the relocation of 15 residences along Pammel Creek. No assessment has yet been made of the significance of structures to be relocated. If this alternative were selected, evaluation would be undertaken as the affected structures were identified. Further testing would also be required at the historic archeological site reported by Gallagher (1980) and discussed under Plan 3 of this section.

5.20 Pammel Creek had been surveyed in 1975 by the University of Wisconsin at La Crosse (1975). The survey results showed much of the Pammel Creek area had been previously disturbed. The Pammel Creek bed has been extensively altered. The 1847 General Land Office (GLO) survey shows the creek emptying into a marshy area to the west in section 9. At a later point, Pammel Creek was diverted to the south along its present drainage. Gallagher (1980) states that the elder Pammel had cut through a rise on his farm in order to straighten the creek. In accomplishing this work, Pammel found shells, projectile points, and ceramic material. This rise also was where John Nugel, an early settler, had built a cabin. The cabin shown on the GLO survey map in section 15 is a likely candidate for the Nugel homestead.

5.21 Neither the Nugel homestead nor the prehistoric site which Pammel located were recorded in the 1975 survey. It is very likely that both these sites, if the section 15 location is correct, have been destroyed by Pammel Creek and its associated levees and by the railroad lines that now pass through this same location.

5.22 Depending upon the selected lower terminus alignment, Plan 10 (channel modification) could adversely impact the Overhead archeological site. The following discussion assesses the impacts of the concrete channel and the various lower terminus alignments on cultural resources.

5.23 Concrete channel: The Nugel homestead and associated archeological site as discussed under Plan 9 are now thought to be destroyed. Neither site was reported by Vehik in the 1975 University of Wisconsin survey. No additional sites have been reported north of the Highway 14 and 61 overpass. Just south of this, the concrete channel would impinge upon the Overhead site as presently defined; however, based upon the results of the survey conducted by Gallagher (1980), the site does not actually extend within the required right-of-way.

5.24 Earth-lined channel (e) and earth pilot channel following the existing alignment (e-3): Both of these alignments would impinge upon the Overhead site boundaries but would not impact the site. These alignments would, however, adversely impact the historical archeological site reported by Gallagher (1980). Further testing would be required at this site if either of these alignments is implemented.

5.25 Earth channel northwest of existing channel (e-1); 80-foot trapezoidal to 10-foot pilot channel (e-5); 5-acre sediment basin control (e-6); and rip-rap channel and control (e-7): None of these alignments would impact upon the Overhead site. All these alternatives, however, would impact upon a small, prehistoric Oneota site. This site contains lithic artifacts, ceramics, and faunal remains in addition to cultural features (Gallagher, 1980). The total size of the site does not exceed 50 square meters. If any of these alignments were to be implemented, further testing would be required to determine the significance of this site.

5.26 Earth channel southeast of existing channel (e-2): This alignment would have an adverse impact upon the Overhead archeological site. Channel construction would bisect the site, totally destroying the cultural components in this section. If this alignment is implemented, this loss would require extensive mitigation of the site.

#### Endangered Species

5.27 In the La Crosse area, bald eagles may be found along the Mississippi River perching or roosting in some of the larger trees. In 1977, one Higgins' eye pearly mussel was found 4 river miles down the Mississippi from the project area near Brownsville, Minnesota.

5.28 The non-structural plans (Plans 3, 4, 5, and 6) would not alter flooding patterns in the area. These plans would preserve existing downstream habitats in their existing condition, and would therefore have no affect on any bald eagles or Higgins' eye pearly mussels which might be in the area.

5.29 Both Plans 9 and 10 call for a pilot channel through the floodplain forest at the lower end of State Road Coulee between the outlet structures and the confluence point on the Mississippi River. This pilot channel would require removal of several large trees and would therefore create possible adverse impacts on the bald eagle. These plans would also transport sediment from State Road Coulee directly into the Mississippi River, and may therefore cover several areas of habitat suitable for the Higgins' eye pearly mussel.

5.30 The selected plan is a variation of Plan 10 which does not include a pilot channel through the wetlands. This plan would greatly reduce the downstream impacts of the project so that no impact on the bald eagle or the Higgins' eye pearly mussel would result.

5.31 The selected plan calls for the removal of only a few trees at the upstream edge of the floodplain forest. These trees are not suitable for use by bald eagles since the trees are far from open water. This plan would have no impacts on trees closer to open water and therefore would have no impact on bald eagles.

5.32 Although at least three individual Higgins' eye pearly mussels have been found in Pool 8 of the Mississippi River (the proposed project is located in Pool 8), the proposed project should not affect this species. A survey conducted for the Corps (Fuller, 1980) sampled three locations in 4 river miles above the proposed project, and three locations in 4 river miles below the proposed project. One sample was less than 1 mile above the confluence between State Road Coulee and the Mississippi River, and another sample was less than 1 mile below this confluence point. No Higgins' eye pearly mussels were found at any of these sample sites, and therefore the presence of this species in the project area is questionable.

5.33 In addition to the questionable presence of this species in the project area, no impacts to Higgins' eye mussel habitat would result from the proposed project. The selected plan does not include a pilot channel to the river. Therefore, sediment carried by discharges from Pammel Creek would settle out in the floodplain in a manner which closely approximates existing conditions during normal flows. However, the increased hydraulic efficiency of the channel would likely cause scouring below the outlet structure with a consequent temporary increase in downstream sedimentation during flood events. Any increase in the sediment load in the river during flood events is not expected to cover any mussel habitat, and therefore should not affect the Higgins' eye pearly mussel.

5.34 Our analysis indicates that the Wisconsin State endangered or threatened species listed in paragraph 4.13, page EIS-15, which may possibly occur in the project area, should not be significantly adversely affected by the selected plan.

#### Water Quality

5.35 A major concern raised during the scoping process was that the proposed action would increase sediment loads in discharge waters and would therefore degrade the area's water quality. Some increase in turbidity during construction is unavoidable; however, the amount of turbidity caused by the project after completion varies among the different plans. The following discussion focuses on the effects of the various plans on turbidity levels.

5.36 The non-structural plans (Plans 3, 4, 5, and 6) would not alter flood patterns in the area. These plans would therefore have no effect on the area's water quality.

5.37 Plan 9 would tend to increase erosion in the floodway and would therefore increase turbidity in Pammel Creek. The downstream effects of this increase in turbidity would probably include declining productivity, covering of benthic habitat, decreases in species diversity, and other detrimental biological effects.

5.38 Plan 10 includes a concrete-lined channel which would decrease much of the upstream erosion and sediment load of Pammel Creek. Plan 10 also includes an earth-lined pilot channel through the floodplain forest in the lower reaches of State Road Coulee. Some erosion would occur along this pilot channel, and would probably cause some temporary increases in turbidity levels at its confluence with the Mississippi River.

5.39 The tentatively selected plan is a modification of Plan 10, but does not include the earth-lined pilot channel through the floodplain in the lower reaches of State Road Coulee. Since the upstream portions of the State Road Coulee channel would still be concrete-lined, the turbidity levels at the outlet structure should be low. The discharge water would be allowed to disperse in the floodplain once it left the outlet structure. Dispersion of discharge waters in this fashion should allow any sediments below the outlet structure which could be resuspended by discharge waters to settle out before reaching the Mississippi River under normal flow conditions. Under the selected plan, turbidity levels and sediment load of State Road Coulee and Mississippi River waters should not change significantly from their present conditions, except during flood events when scouring below the outlet structure would increase the sediment load downstream.

## SECTION 122 (P.L. 91-611) CONSIDERATIONS

### Social Impacts

5.40 The following aspects of the social and economic environment (from Section 122, 1970 R HA, Public Law 91-611) would not be significantly affected: noise, population density, displacement of people, aesthetic values, community cohesion, (desirable) community growth, public facilities, public services, (desirable) regional growth, and displacement of farms. Although some of these aspects would be affected, the effect would be insignificant in the context of the present urban setting of La Crosse.

5.41 There would be a short-term minor increase in local business activity and employment during construction of the proposed project. Property values of both undeveloped land and developed properties would increase somewhat on former floodplain areas. This should raise local tax revenues from these properties.

5.42 Depending on local sponsorship of the project, one social impact may be inequities in the distribution of project benefits and costs. Benefits to those in the present floodplain are flood damage reduction; benefits to those in upstream areas include the ability to continue the development of those areas without incurring conflict with downstream residents who could perceive that development as increasing flood stages, in the absence of a project. Costs to floodplain occupants include all normal construction-related impacts. If the County of La Crosse assumes local sponsorship of the project, financial costs could be spread throughout the county; however, if the city of La Crosse should assume local sponsorship, those costs could be borne by a smaller group of taxpayers, including those bearing the construction-related impacts.

### Other Impacts

5.43 The environmental resources covered by Section 122 have been discussed elsewhere (water, significant natural resources, and cultural resources) or are deemed to be negligibly impacted by any plan (such as air quality). Impacts to other man-made resources would be negligible except for the upgrading of some public facilities along the proposed project route.



## 6.00 PUBLIC INVOLVEMENT

### PUBLIC INVOLVEMENT PROGRAM

6.01 A Notice of Intent to Prepare a Draft Environmental Impact Statement for a Proposed Flood Control Project, State Road Coulee at La Crosse, Wisconsin, appeared in the Federal Register on 22 February 1980. This notice invited participation in the scoping process by anyone who was interested.

6.02 A formal scoping meeting held in La Crosse on 11 April 1980 was attended by representatives of the U.S. Fish and Wildlife Service, Soil Conservation Service, U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, Wisconsin Department of Transportation, City of La Crosse, Town of Shelby, La Crosse County, and several interested local residents.

6.03 A final scope was distributed to the public on 13 June 1980. The final scope incorporated the views expressed by Federal, State, and local agencies, and interested citizens. Throughout the study, coordination has been maintained between the St. Paul District and Federal, State, and local government agencies and interested citizens. All suggestions for plan modifications were investigated by the District for feasibility. At a meeting attended by representatives of the Wisconsin Department of Natural Resources, and the U.S. Fish and Wildlife Service on 23 September 1980, the recommended plan for channel modification for State Road Coulee was chosen as the most environmentally acceptable structural plan for flood damage reduction. A detailed discussion of public involvement is presented in Appendix I.

### REQUIRED COORDINATION

6.04 Following coordination of the draft EIS with appropriate agencies, groups, and individuals, a public meeting will be held. Comments received at the meeting and by letter will be used in preparation of the planning reports and final EIS. Routine coordination with appropriate agencies will continue throughout the study process.

6.05 In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, the draft EIS contains a biological assessment of impacts on federally-listed or proposed endangered species which may be affected by the project.

6.06 This document also contains the report to the Advisory Council on Historic Preservation concerning potential project impacts on the Overhead archeological site listed on the National Register of Historic Places.

6.07 Continued coordination with State and local agencies will be necessary to identify environmentally acceptable disposal sites and/or to locate potential users of excavated material.

6.08 Because the proposed plan involves placement of fill material in waters of the U.S., a Section 404(b)(1) evaluation of the effects of fill placement will be prepared and circulated with the main report and the EIS for compliance with the Clean Water Act of 1977, Public Law 92-500, as amended.

6.09 The U.S. Fish and Wildlife Service Stage II Draft Fish and Wildlife Coordination Act report of 5 November 1980 on the State Road Coulee Project is included as Exhibit 16 of Appendix I. The recommendations made for the project in that report are specifically addressed in the draft Phase I GDM (p. 119).

## STATEMENT RECIPIENTS

6.10 The following agencies, organizations, and individuals will be sent copies of this EIS or notified of its availability.

**U.S. Environmental Protection Agency**

Office of Federal Activities, Washington, D.C.  
Region V, Chicago, Illinois

**U.S. Department of Agriculture**

Forest Service, Region 9, Milwaukee, Wisconsin  
Forest Service, Broomall, Pennsylvania  
Soil Conservation Service, River Basin Planning Board, Washington, D.C.  
Soil Conservation Service, Wisconsin State Conservationist  
Soil Conservation Service, District Office, La Crosse, Wisconsin

**U.S. Department of Commerce**

Deputy Assistant Secretary for Environmental Affairs, Washington, D.C.  
Water Resources Management Division, Gloucester, Massachusetts  
District Office, Milwaukee, Wisconsin

**U.S. Department of Energy**

Division of NEPA Affairs, Washington, D.C.  
Federal Energy Regulatory Commission, Washington, D.C.  
Federal Energy Regulatory Commission, Chicago, Illinois

**U.S. Department of Health and Human Services**

Deputy Assistant Secretary for Environmental Affairs, Washington, D.C.  
Region V, Chicago, Illinois

**U.S. Department of Housing and Urban Development**

Region V, Chicago, Illinois  
Area Office, Milwaukee, Wisconsin

**U.S. Department of the Interior**

Assistant Secretary for Program Policy, Washington, D.C.  
Fish and Wildlife Service, Regional Office, St. Paul, Minnesota  
Fish and Wildlife Service, Area Office, Green Bay, Wisconsin  
Fish and Wildlife Service, Northern Prairie Wildlife Research Center, La Crosse, Wisconsin  
Fish and Wildlife Service, Upper Mississippi National Wild Life and Fish Refuge, La Crosse, Wisconsin  
Bureau of Indian Affairs, Minneapolis, Minnesota  
Geological Survey, Denver, Colorado  
Geological Survey, Reston, Virginia  
Heritage Conservation and Recreation Service, Ann Arbor, Michigan

**U.S. Department of Transportation**

Federal Highway Administration, Homewood, Illinois  
Federal Highway Administration, Madison, Wisconsin  
Ninth Coast Guard District, Cleveland, Ohio

Advisory Council on Historic Preservation, Washington, D.C.

Upper Mississippi River Basin Commission, Minneapolis, Minnesota

State of Wisconsin

Department of Administration, Madison  
Department of Agriculture, Madison  
Division of Health, Madison  
Department of Natural Resources, Madison  
Department of Natural Resources, La Crosse  
Department of Transportation, Madison  
Department of Transportation, La Crosse  
State Archaeologist, Madison  
State Board of Soil and Water, Madison  
State Historical Society, Madison  
Federal Property Program, Madison

Mississippi River Regional Planning Commission

City of La Crosse

County of La Crosse

Town of Shelby

University of Wisconsin, Library, La Crosse

University of Wisconsin, Library, Madison

University of Wisconsin, River Studies Center, La Crosse

La Crosse Public Library

State Road School, La Crosse, Wisconsin

La Crosse News Agency

La Crosse Times Review

La Crosse Tribune

Milwaukee Journal Sentinel

Country Living, La Crosse

Waterways Journal, St. Louis, Missouri

WKBT-TV, La Crosse, Wisconsin

WLCX, La Crosse, Wisconsin

WXOW-TV, La Crosse, Wisconsin

Environmental Defense Fund, Washington, D.C.

Izaak Walton League, Wisconsin Division, Elm Grove

Midwestern Gas Transmission, Wadena, Minnesota

National Audubon Society, Madison, Wisconsin

National Audubon Society, Jamestown, North Dakota

National Wildlife Federation, Mandan, North Dakota

Nature Conservancy, Madison, Wisconsin

Sierra Club, Madison, Wisconsin

Wisconsin League of Women Voters, Madison, Wisconsin

H. Paul Friesema, TIE, Butler University, Indianapolis, Indiana

Hillview Estates, La Crosse, Wisconsin

Hoeschler Realty, La Crosse, Wisconsin

Jack Hoeschler, St. Paul, Minnesota

Roger Horstman, La Crosse, Wisconsin

David Kidd, La Crosse, Wisconsin

John M. Landro, La Crosse, Wisconsin

Preston Michie, Portland, Oregon

Howard Robers, La Crosse, Wisconsin

## PUBLIC VIEWS AND RESPONSES

6.11 Public participation activities carried on during the studies for State Road and Ebner Coulees went through two separate stages. The first stage (1974-76) involved intensive contact with the State Road-Ebner Coulees Citizen Advisory Committee which led to the development of a recommended plan and the November 1976 draft report. The second stage (1978-1980) involved updating the November 1976 draft report and resolving questions issued by agencies and private individuals. The second stage took longer than expected because of (1) the delays in establishing the 10-, 50-, 100-, and 500-year flood insurance outlines and profiles; (2) the time necessary to develop an acceptable environmental plan; and (3) other related problems.

6.12 Coordination for the current study involved phone contacts, letters, and several meetings with local, State, and Federal interests. The current study effort was initiated in fiscal year 1979, but was delayed by the need to determine the 100-year floodplain outline in an ongoing flood insurance study.

6.13 Many public views expressed during the public involvement program had a major influence on the study and were considered in the decision-making process. Of primary concern were the flooding problems and associated damages to residential properties and public health and safety concerns. There was also considerable local sentiment for development of a plan that would minimize land requirements and relocations of existing residences. The U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources strongly opposed the earth pilot channel feature which was originally included in the authorized State Road Coulee plan, and they expressed concern over potential increased development in the present floodplain if the project reduced the size of the 100-year floodplain. Concern was also expressed that every effort be made to avoid the Overhead archeological site listed on the National Register of Historic Places.

# LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement:

<u>Name</u>	<u>Discipline/Expertise</u>	<u>Experience</u>	<u>Role in Preparing EIS</u>
Ms. Jeannie Wagner	Biology/Wildlife	2 years EIS studies, St. Paul District	Effects on wildlife resources, wetlands
Mr. John Kittleson	Biology/General	1 year EIS studies, St. Paul District	Effects on endangered species, water quality
Mr. Robbin Blackman	Biology/Fisheries, General	10 years EIS studies, Corps of Engineers	EIS Coordinator, effects on fisheries resources
Mr. Carl Stephan	Engineering/Civil, Water Resources	10 years water resources, Corps of Engineers; 12 years hydraulic engineering, Bureau of Sport Fisheries and Wildlife	Study Manager, formulation of alternatives, needs assessment
Mr. David Berwick	Archeologist	3 years cultural resources studies, St. Paul District; 5 years cultural resources studies, State Historical Society of Wisconsin	Effects on cultural resources
Ms. Suzanne Gaines	Sociologist	1 year EIS studies, St. Paul District	Social effects
Mr. Frank Star	Outdoor Recreation Planning	5 years recreation planning, St. Paul District; 1 year State of Minnesota	Effects on recreation resources and aesthetics

404(b)(1) EVALUATION  
FLOOD CONTROL, STATE ROAD  
COULEE, LA CROSSE, WISCONSIN

INTRODUCTION

The authorized flood damage reduction plan for La Crosse, Wisconsin, originally included channel modifications to both Ebner and State Road Coulees. Because further study has shown the Ebner Coulee modifications to be economically infeasible, this 404(b)(1) evaluation does not include analysis of the Ebner Coulee proposal.

The proposed modifications to the State Road Coulee are expected to produce very few adverse biological impacts because the coulee does not provide good habitat for most species. Since flows in the coulee are low and since the drainage area is less than 6 square miles, most of the proposed construction and fill activity also meets Section 404 requirements under the Nationwide Permit Authority.

The proposed outlet structure for State Road Coulee would be constructed in bottomlands adjoining the Mississippi River, below the ordinary high water level of the river. This means the outlet structure would not meet Section 404 requirements under the Nationwide Permit Authority. Given the above information, the following evaluation, in accordance with the requirements of Section 404 of the Clean Water Act of 1977, will consider the effects of the proposed construction and fill activity as they relate to the riverine forested wetland which lies between the proposed outlet structure and the Mississippi River.

1. PROJECT DESCRIPTION

The proposed flood damage reduction plan would increase the capacity of State Road Coulee by deepening and enlarging the downstream portion of the channel. The portion of the proposed action of concern for this 404(b)(1) evaluation is the construction of the outlet structure and the downstream effects of the discharge waters after project completion.

The proposed outlet structure would be trapezoidal in profile and would measure approximately 200 feet by 340 feet (see p. 52, GDM). It would be constructed of rock fill material and designed to pass the 100-year flood (5,000) cubic feet per second (cfs).

a. Description of the proposed discharge of dredged or fill materials

(1) General characteristics of the material - The material used for construction of the outlet structure would probably be quarry-run rock, with 50 percent of the rocks heavier than 21 pounds.

(2) Quantity of material proposed for discharge - Construction of the outlet structure would require approximately 3,000 cubic yards of riprap and filter material.

(3) Source of material - No source for the fill material has been identified, although a possible source may be limestone from a local quarry.

b. Description of the proposed discharge site for dredged or fill material.

(1) Location and areal extent - The proposed action would provide flood damage protection for the city of La Crosse, Wisconsin. The proposed outlet structure would empty into the Mississippi River floodplain, and it would be located south of La Crosse near the intersection of State Highway 61 and the Burlington Northern Railroad tracks (see pp. 46 and 57, GDM). This outlet structure would cover an area approximately 200 feet by 340 feet.

(2) Type of discharge site - The outlet structure would be constructed in the Mississippi River floodplain forest. The area is relatively flat, and is characterized by typical bottomland hardwood species (reed canary grass (*Phalaris graminacea*), box-elder (*Acer negundo*), green ash (*Fraxinus americana*), and slippery elm (*Ulmus rubra*)).

(3) Method of discharge - The proposed outlet structure would be built using standard construction procedures which would probably utilize dump trucks and a crane for placement of the fill material.

(4) When will discharge occur? - Construction of the outlet structure would probably occur at times of low or average flow, or when the river is frozen.

(5) Projected life of discharge site - The proposed project would be hydraulically adequate for a 100-year (1-percent) frequency design flood, and would have an intended life of 100 years.

(6) Bathymetry (if open water discharge) - Not applicable. No open water discharge is proposed in conjunction with this project.

2. PHYSICAL EFFECTS

The proposed channel modifications would create water velocities at the outlet structure which are greater than those currently found in the channel. These increased velocities would cause scouring along the existing channel immediately below the outlet structure and deposition of this material further downstream. The impacts of the increased water velocities would be greatest in the first years following project completion, and would lessen as the discharge flows established a stabilized channel and the downstream ecosystem adjusted to the new flow pattern.

a. Potential destruction of wetlands - effects on (40 CFR 230.4-1(a)(1)(i-vi))

Wetlands affected by construction of the proposed project are the riverine forested wetlands bordering the Mississippi River.

(1) Food chain production - During the first few years, food chain production would undergo decreases as vegetation is destroyed by changes in the existing flow pattern. In later years, the new flow pattern would become better established, allowing vegetation to recolonize some of the affected areas, and allowing food chain production to increase.

(2) General habitat - In the first few years after completion of the project, impacts on habitat would result from scouring below the outlet and displacement of sediments downstream. Habitat most likely affected would be the mature bottomland hardwoods, and the reed canary grass marsh habitat nearer the Mississippi River. In later years, the discharge from the outlet structure would become better channelized, and some of the disturbed vegetation would become reestablished. Overall, a minor habitat shift in some areas from climax bottomland hardwoods to earlier successional stages (e.g., reed canary grass) might be the net result.

(3) Nesting, spawning, rearing, and resting sites for aquatic or land species - A main concern in the proposed channel modification is its effect on a northern pike spawning area located 300-400 meters southeast of State Road Coulee's confluence with the Mississippi River. It is possible that increased turbidity and sediment load in State Road Coulee waters during construction would have minor adverse impacts on the spawning area. Upon completion of the project and the subsequent channel stabilization below the outlet structure, the turbidity and sediment load should drop. Other disturbances may result from the scouring caused by the increased water velocities in the improved channel during a flood event. Since a flood event on State Road Coulee is most likely to occur during summer months, its impacts would be on the northern pike spawning habitat, not on the actual spawning activity.

Other impacts on nesting, spawning, rearing, and resting sites immediately below the outlet structure would result from the scouring caused by increased water velocities and changes in channel configuration below the outlet structure until a new channel becomes stabilized. The overall impact of these losses is expected to be minor since the amount of habitat affected would be small in respect to total habitat available.

(4) Those areas set aside for aquatic environment study, sanctuaries, or refuges - The discharge waters from the proposed improved channel would flow through a section of the Upper Mississippi National Wild Life and Fish Refuge. During the first few years, disruption of the ecosystem in a small section of the refuge could occur. It is anticipated that sometime within the first 10 years following project completion, the channel would become stabilized and therefore reduce the area of impact. Eventually, vegetation would reestablish in some of the impacted areas, thereby mitigating some of the earlier losses.

In contrast to the plan authorized in 1968, the proposed plan contains no flood-plain channel. It was felt that a longer channel would increase project impacts on the Mississippi River, the associated bottomlands, and therefore on the refuge. The longer channel would have provided a more direct line to the Mississippi River, and would have necessitated removal of approximately 600 trees. For these reasons, the longer channel was dropped in favor of allowing the discharge flow to establish its own drainage pattern.



(5) Natural drainage characteristics - The natural drainage pattern of State Road Coulee below the site of the proposed outlet structure would be changed. The existing drainage pattern consists of one main channel leading to the Mississippi River. Anticipated changes would result from increased water velocities and would probably include straightening and widening the existing channel, plus the possible cutting of new channels parallel to the current channel.

(6) Sedimentation patterns - Sedimentation patterns would change as a result of the proposed action. The sediment load of the water in the improved channel would be less than under current conditions since the channel would be concrete. The proposed channel would also be more hydraulically efficient, and would result in greater water velocities at the outlet structure during flood events. Higher velocities would likely change existing erosion and sedimentation patterns below the outlet structure. Greater rates of erosion immediately below the outlet structure and displacement of sediment further downstream would occur and would contribute to the sediment load of the Mississippi River during flood events. After stabilization of a new channel below the outlet structure and vegetative recovery, contributions of sediment to the river should approach existing conditions because of the concurrent elimination of erosion from the concrete channel upstream.

(7) Salinity distribution - Not applicable.

(8) Flushing characteristics - The proposed action would result in a change in the rate of flushing during flood events in the floodplain forest adjacent to the Mississippi River because of the increased hydraulic efficiency of the channel. Temporary impacts of this change include increased scouring, washing of organic material from the area, some sedimentation in areas of low current velocities, and better oxygenation of the water flowing through the area.

(9) Current patterns - Changes in the current pattern below the outlet structure would result from the increased hydraulic efficiency of the proposed improved channel. Higher current velocities would straighten the existing channel below the outlet structure and would probably change current patterns at the point of confluence with the Mississippi River. The proposed action would not change current patterns in the Mississippi.

(10) Protection from wave action, erosion, and storm damage - No impact on wetlands critical to this type of protection would result from the proposed action.

(11) Storage areas for storm- and floodwaters - No significant storage areas would be affected by the proposed action.

(12) Prime natural recharge areas - The proposed action would not have any significant effect on water recharge areas.

b. Impact on water column (40 CFR 230.4-1(a)(2))

(1) Reduction in light transmission - Increased turbidity during construction would cause reduction of light transmission in the water column. After completion of the project, the discharge water from the State Road Coulee outlet structure would be less turbid than existing discharges. This decrease in turbidity would probably be offset by temporary increases in turbidity during flood events caused by increased erosion in the bottomland area.

(2) Aesthetic values - Other than temporary increases in turbidity during construction and flood events, no impact on the aesthetic value of the water column is anticipated.

(3) Direct destructive effects on nektonic and planktonic populations - Increases in turbidity during construction would temporarily disrupt primary productivity in parts of the stream. After completion of the project, increased current velocities during flood events would preclude some species from living in the area, and increased scouring of the channel below the outlet structure may flush away some existing algae and rooted macrophytes. After the project has been in operation for several years, the channel below the proposed outlet structure should stabilize and recolonize with new nektonic and planktonic populations.

c. Covering of benthic communities (40 CFR 230.1(a)(3))

(1) Actual covering of benthic communities - Some covering of benthic communities would occur when the sediment scoured from the area below the outlet structure settled out in the downstream reaches during flood events. The benthic communities most likely to be covered are those near the confluence of State Road Coulee and the Mississippi River. The sediment carried into the river should quickly settle out so that it will have little impact on benthic communities further downriver.

The proposed outlet structure would cover a small amount of benthic habitat. The effects of this covering on the area's benthic population would be insignificant.

(2) Changes in community structure or function - Increased current velocity from the proposed outlet structure would cause scouring and erosion near the structure and sedimentation further downstream during flood events. After the project has been in operation for several years, coarse sediment would be found near the outlet structure with finer sediment further downstream. Benthic communities would reflect these conditions with species adapted to higher current velocities and coarser substrates becoming established nearer the outlet structure.

d. Other effects

(1) Changes in bottom geometry and substrate composition - A wider and straighter channel from the proposed outlet structure to the river would develop due to the increased current velocities. The substrate in the new channel would grade from coarse substrates near the outlet structure to finer substrates further downstream.

(2) Water circulation - No change in water circulation is anticipated as a result of the proposed project.

(3) Salinity Gradient - Not applicable.

(4) Exchange of constituents between sediments and overlying water with alterations of biological communities - In the reach below the proposed outlet structure, some exchange between sediments and overlying water would occur as a result of the scouring associated with the higher current velocities.

This exchange is not anticipated to alter biological communities since the period of exchange would occur only during flood events and would be brief.

3. CHEMICAL-BIOLOGICAL INTERACTIVE EFFECTS (40 CFR 230.4-1(b))

a. Does the material meet the exclusion criteria?

The exclusion criteria state that:

"Dredged or fill material may be excluded from this evaluation if the material is composed predominantly of sand, gravel or any other naturally occurring sedimentary material with particle sizes larger than silt, characteristic of and generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels." (40 CFR 230.4-1 (b)(1)(i)).

The fill material used for construction of the outlet structure would meet this exclusion criteria because it would be composed predominantly of naturally occurring material (rock) with particle size larger than silt. Since the fill material would meet the exclusion criteria, no further testing under 40 CFR 230.4-1(b)(2) and (3) is required.

4. DESCRIPTION OF SITE COMPARISON (40 CFR 230.4-1(c))

a. Total sediment analysis (40 CFR 230.4-1(c)(1))

No sediment analysis has been performed at this site. The use of clean fill presents no major environmental impact in regard to concentration differences of critical constituents between the fill sites and the fill material.

b. Biological community structure analysis (40 CFR 230.4-1(c)(2))

No biological community structure analysis was performed. The use of clean, large-sized fill material should preclude the community structure analysis because no adverse impacts would be a direct result of this type of fill.

5. REVIEW APPLICABLE WATER QUALITY STANDARDS

a. Compare constituent concentrations

Since clean non-liquid fill material would be used, no adverse impact on the area's water quality is anticipated. Although increases in turbidity levels would probably result during construction and during flood events, these increases would be of short duration and would have no significant effects on the downstream water quality in either State Road Coulee or the Mississippi River.

b. Consider mixing zone

Not applicable. No liquid would be discharged.

c. Based on a. and b. above, will disposal operation be in conformance with applicable standards?

Fill activities would be in conformance with Wisconsin State standards, except during construction and flood events when turbidity levels could exceed acceptable limits. This effect would be temporary, and should not have any long-term, adverse effects on the environment.

6. SELECTION OF DISPOSAL SITES (40 CFR 230.5) FOR DREDGED OR FILL MATERIAL

a. Need for the proposed activity

State Road Coulee has a drainage area of 6 square miles on the east side of La Crosse, Wisconsin. The drainage area is steep and rugged which allows for quick transportation of rainwater into the lower reaches of the watershed. Flooding is most frequent in the summer months, when severe thunderstorms occur over the upper reaches of the watershed. Flood damage potential has become progressively more serious with relatively recent residential development of the flood-prone areas. The proposed flood damage reduction plan is needed to prevent an estimated 2.2 million dollars of average annual damages.

b. Alternatives considered - Twelve plans were considered during the planning process. Six of these plans were eliminated during the early stages of the study, and the remainder were given detailed consideration. Plans eliminated early in the study included flood warning and emergency protection, floodplain evacuation, upstream reservoirs, and various forms of channel diversion and modification. These plans were eliminated because of adverse social impacts, economic infeasibility, or failure to meet specific planning objectives.

Plans considered in greater detail included flood proofing, flood insurance, floodplain regulation, floodway system, and channel modifications. The three non-structural plans (flood insurance, floodplain regulation, and flood proofing) were later eliminated because they did not adequately meet planning objectives. The floodway system was also eliminated because adverse social and environmental impacts were significant.

The selected plan (channel modification) was then broken into several alternative types of modification and several possible channel alignments. The alternative type of channel modification included: earth-filled channels, riprap-lined channels, concrete-lined channels, concrete-lined plus enclosed channels, and concrete-lined plus riprap-lined channels (several possible alignments were considered with this alternative). The final plan selected called for channel modifications with concrete-lined plus riprap-lined channels, and utilized the least environmentally damaging alignment. This selected plan is also the NED and least environmentally damaging plan.

c. Objectives to be considered in discharge determination (40 CFR 230.5(a))

(1) Impacts on chemical, physical, and biological integrity of the aquatic ecosystem (40 CFR 230.5(a)(1)) - Since clean fill material would be used, the proposed action would have no impacts on the chemical integrity of the aquatic ecosystem.

The proposed action would cause some changes in the physical characteristics of the lower reaches of State Road Coulee. Construction of the outlet structure would cover approximately 200 feet of existing channel length. Increased current velocities during flood events below the outlet structure would cause scouring and erosion along with sedimentation in the downstream reaches. The final result would be changes in existing substrate to coarser substrate near the outlet structure and finer further downstream. These physical changes would not have any significant effects outside the local area.

Some changes in the biological integrity of the aquatic ecosystem would result from the changes in the physical characteristics. Species composition of the benthic community would change as species better adapted to the new conditions become established. Effects on the nektonic and planktonic communities would be temporary, occurring during construction and flood events.

(2) Impact on food chains - During construction and flood events, increases in turbidity levels may result in a drop in primary productivity, and disrupt food chains in some areas. These effects would be temporary, and therefore should not significantly affect food chains.

Changes in the benthic community could disrupt food chains; however, the stream's benthic community is small and cannot support many other organisms. Therefore, changes in the benthic community should not significantly affect food chains.

(3) Impact on diversity of plant and animal species - The proposed project should not cause significant decreases in plant and animal diversity in the downstream (below the outlet structure) portion of the project. Construction activity and the increased hydraulic efficiency of the improved channel could result in sedimentation at the creek's confluence with the Mississippi River, causing a minor loss of diversity in this area. The declines of this nature should return to pre-project levels after the ecosystem has had a chance to adjust to the flows associated with the proposed project.

(4) Impact on movement into and out of feeding, spawning, breeding, and nursery areas - Movement in and out of the existing Pammel Creek channel which would be cut off between U.S. Highway 14/61 and the outlet structure would be largely curtailed. No other significant disruptions of movement patterns would be anticipated.

(5) Impact on wetland areas having significant functions of water quality maintenance - The proposed fill activities would not affect wetland areas serving this function.

(6) Impact on areas that serve to retain natural high waters or flood waters - The proposed project would hasten drainage of the State Road Coulee watershed. The downstream effects of this drainage would be concentrated on the Mississippi River floodplain and are relatively small, since there is little probability of a concurrent flood event on the Mississippi River and State Road Coulee.

(7) Methods to minimize turbidity - The use of clean fill material consisting of large rocks from the nearby area would minimize turbidity increases. In spite of this precaution, temporary increases in turbidity will likely occur during construction and flood events.

(8) Methods to minimize degradation of aesthetic, recreational, and economic values - Possible impacts in these categories include the removal of several (probably less than 30) mature trees, and any impacts on fish and wildlife resources resulting from disruption of the floodplain forest and marsh habitat. The final placement of the outlet structure would be designed to minimize these losses.

(9) Threatened and endangered species - The U.S. Fish and Wildlife Service lists the bald eagle (Haliaeetus leucocephalus) and the Higgins' eye pearly mussel (Lampsilis higginsii) as endangered species which may be affected by the proposed project.

Only wintering bald eagles would occur in the project area. These eagles require large trees near open water for roosting, hunting perches, and loafing. The proposed construction activity would not affect any large trees near open water, and therefore should have no effects on the bald eagle.

The Higgins' eye pearly mussel has been found in at least three locations in Pool 8 of the Mississippi River (State Road Coulee flows into Pool 8). In a survey conducted for the Corps (Fuller, 1980), the closest of these three records was approximately 4 river miles below the confluence of State Road Coulee and the Mississippi River. Another study conducted in 1978 for the Corps sampled several sites in Pool 8 and found no Higgins' eye pearly mussels. One of the sites sampled was less than 1 mile downstream of the proposed project, another less than 1 mile upstream from the proposed project. Since none of these mussels were found in this survey, the existence of the Higgins' eye pearly mussel in the marginal habitat found in the project area is questionable. In addition, the proposed project should not significantly increase sediment load in the Mississippi River. No impact on the Higgins' eye pearly mussel is anticipated from the proposed action.

(10) Investigate other measures that avoid degradation of aesthetic, recreational, and economic values of navigable waters - Several other alternatives to the proposed action were investigated (see 6.b., p. EIS-34). The selected plan (10e-7) is considered to be the least environmentally damaging structural plan.

d. Impacts on water uses at proposed site (40 CFR 230.5(b)(1-10))

(1) Municipal water supply intakes - No municipal water supply intakes are found in the project area; therefore, no adverse impacts are anticipated.

(2) Shellfish - To date, no shellfish have been found in State Road Coulee. Any shellfish existing near the confluence with the Mississippi River may be affected by project-caused sedimentation during construction and flood events, but because the area affected would be relatively small, the overall effects on shellfish should not be significant.

(3) Fisheries - A potential effect of the proposed action on the area's fisheries could be damaging the northern pike spawning habitat found in the floodplain marshy areas between the outlet structure and the confluence with the Mississippi River. Although construction would be scheduled so as not to interfere with the spawning time, the habitat itself may be damaged by the proposed action. Possible damages include scouring of substrates, algae and rooted macrophytes, covering the habitat with sediment, and blocking movement corridors. The final placement of the outlet structure will be determined to minimize the effects on this spawning habitat.

(4) Wildlife - Some wildlife habitat would be affected by erosion and destruction of a small amount of vegetation. The selected plan has been designed so that wildlife habitat losses could be reduced as much as possible.

(5) Recreation activities - The only adverse recreation impacts could indirectly result from disruption of the area's fisheries due to damage of the spawning habitat. This should not significantly change the recreational use patterns in the project area.

(6) Threatened and endangered species - See section 6.c.(9) and pp. EIS-14, 15, 20 and 21.

(7) Benthic life - Disruption of the benthic community would result from the proposed action. In the first years following project completion, increased erosion and scouring are expected to change benthic habitat and to eliminate some of the benthic organisms currently found in the lower reaches of State Road Coulee. In later years, the ecosystem should stabilize and provide habitat for benthic populations adapted to the new flow conditions. Currently, the benthic community is small, and is not a good food source for higher trophic levels. Therefore, the impacts on this community should not have significant effects on the ecosystem.

(8) Wetlands - The proposed action would affect the riverine forested wetlands between the proposed outlet structure and the Mississippi River. Construction of the outlet structure would require removal of approximately 1 acre of vegetation. An estimated additional acre of vegetation might be lost to erosion during large flood events following project construction.

The effects on the wetland ecosystem would be greatest in the first few years following completion of the project. During this period erosion, scouring, and degradation of the channel would destroy vegetation and disrupt the ecosystem. In later years, the ecosystem should stabilize as the discharge flow pattern from the improved channel becomes established, and vegetation recovers. The floodplain community has considerable resiliency and should be able to undergo much vegetative recovery.

(9) Submersed vegetation - Very little aquatic vegetation is found in State Road Coulee due to the instability of the substrate and the irregularity of the flows. Any submersed vegetation in the lower reaches of the coulee would probably be destroyed by erosion or siltation upon completion of the project. Since there is so little aquatic vegetation, its loss should not have significant impacts on the biotic community.

Aquatic vegetation is more prevalent around the confluence of State Road Coulee and the Mississippi River. Some of this vegetation may be lost to erosion and sedimentation during construction and flood events.

(10) Size of the disposal site - The size of the proposed outlet structure is the smallest possible which would provide sufficient capacity for discharge of design flows.

(11) Coastal zone management programs (40 CFR 230.3(e)) - Not applicable. The proposed fill activity would not affect coastal zone management plans.

e. Considerations to minimize harmful effects (40 CFR 230.5(c)(1-7))

(1) Water quality criteria - Since clean material from a local source would be used, no effect on water quality should result from the fill itself. The proposed concrete channel would improve the water quality of the discharge waters by lowering turbidity levels below existing conditions. Increased discharge flow velocity would increase the sediment load and turbidity at the coulee's confluence with the Mississippi River. This would only occur during a flood event and these increases in turbidity and sediment load should be the only water quality criteria exceeded by the operation of the proposed project.

(2) Investigate alternatives to open water disposal - The proposed outlet structure must be constructed in the specified location for adequate operation of the flood control project.

(3) Investigate physical characteristics of alternative disposal sites - The selected disposal site is the most appropriate for the type of construction proposed.

(4) Ocean dumping - Not applicable.

(5) Where possible, investigate covering contaminated dredged material with cleaner material - Not applicable. All fill material would be clean.

(6) Investigate methods to minimize effect of runoff from confined areas on the aquatic environment - Not applicable. The fill material would all be clean and no confined areas would be used.

(7) Coordinate potential monitoring activities at disposal site with EPA - No monitoring activities are planned due to the clean nature of the fill material.



7. STATEMENT AS TO CONTAMINATION OF FILL MATERIAL IF FROM A LAND SOURCE (40 CFR 230.5(d))

Quarry-run stone for fill would be clean and purchased from a nearby quarry. No contaminants should be added to the water from the fill materials.

8. DETERMINE MIXING ZONE

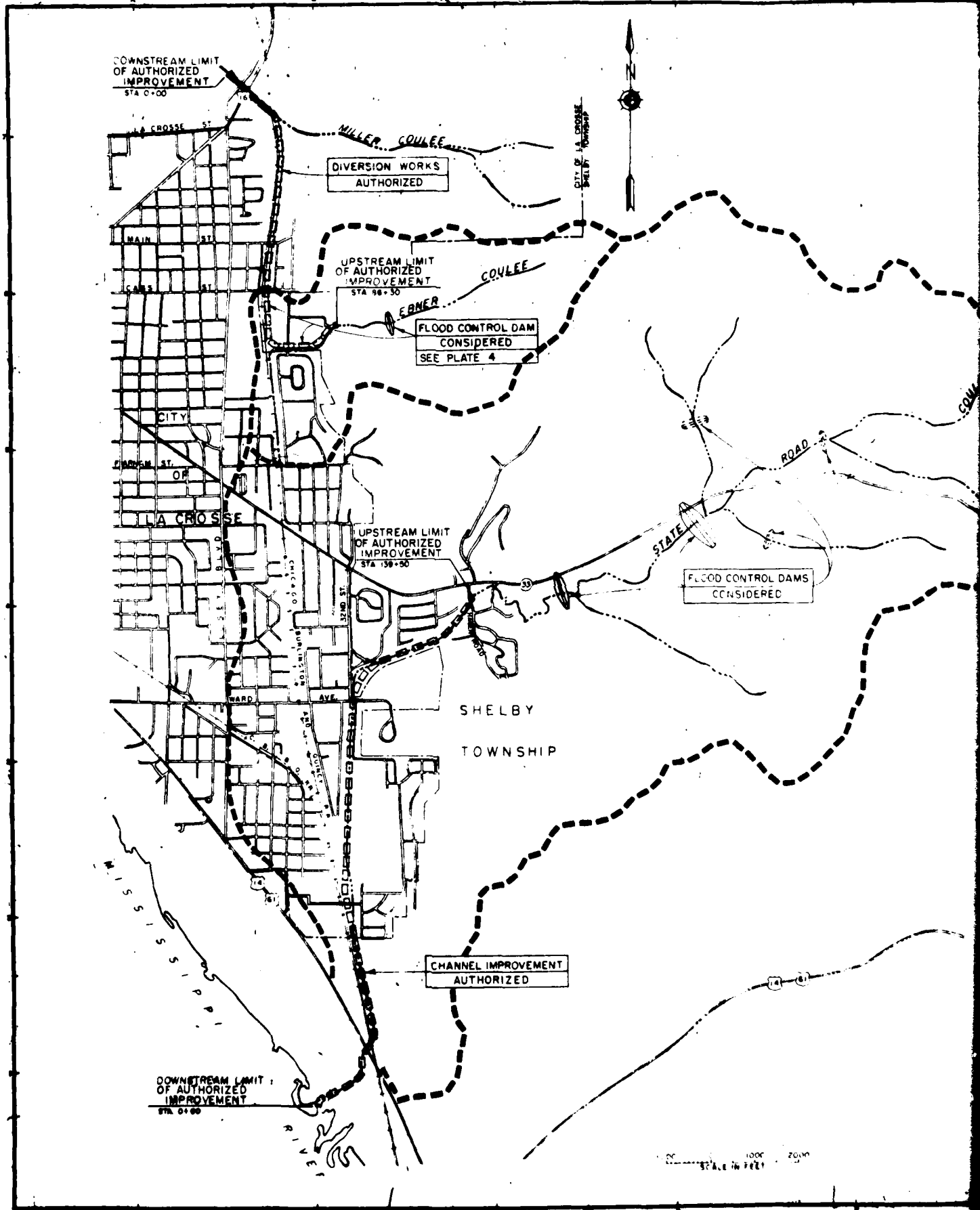
Not applicable. No liquid material would be discharged into the river.

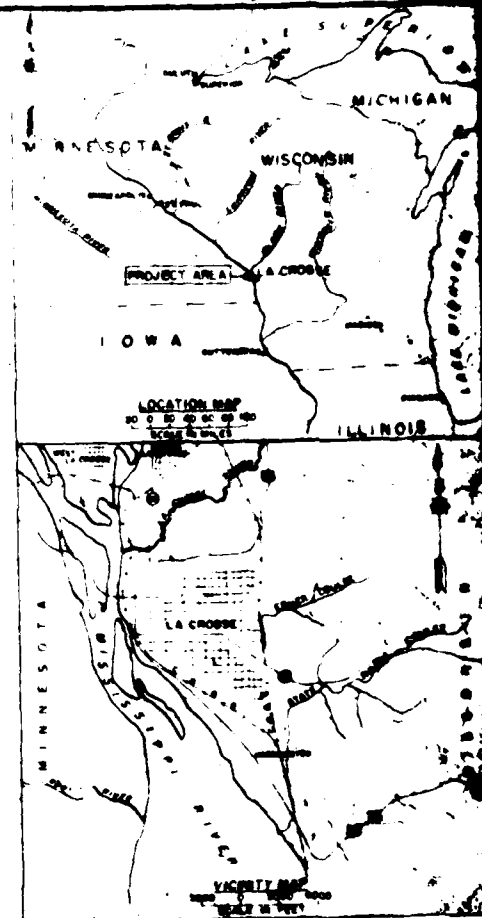
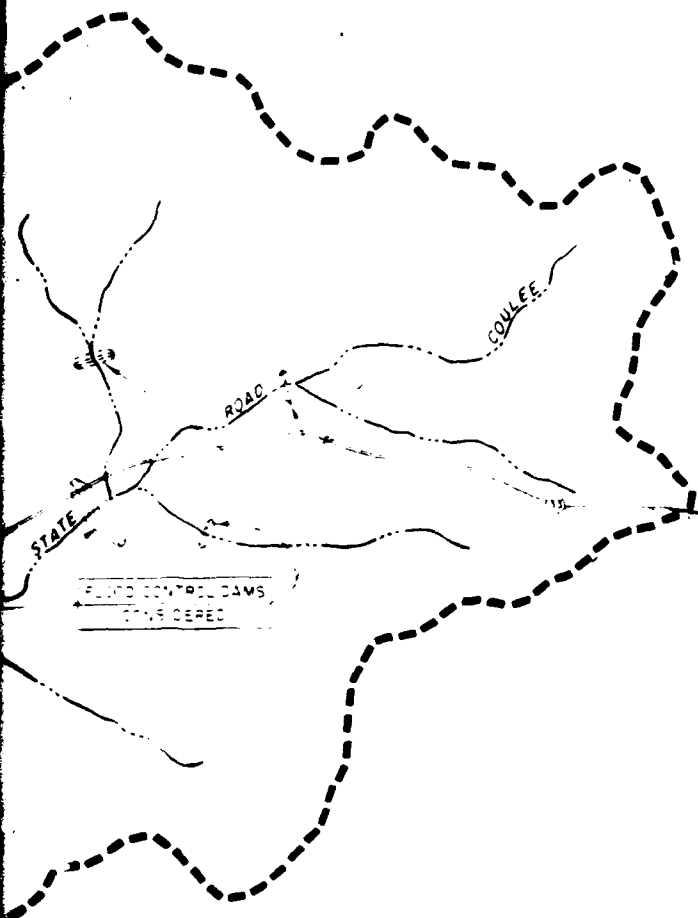
# REFERENCES

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- Fuller, Samuel L.H. 1980. Freshwater Mussels (Mollusca: Bivalvia: Unionidae) of the Upper Mississippi River: Observations at Selected Sites Within the 9-foot Navigation Channel, 1977-1979. Report No. 79-24F. Academy of Natural Sciences of Philadelphia.
- Gallagher, James P. 1980. A Cultural Resources Investigation of the State Road and Ebner Coulee Flood Control Project, La Crosse, Wisconsin. Report prepared for the U.S. Army Corps of Engineers, St. Paul District (Contract No. DACW37-80-C-0028).
- Penman, John T. 1978. Highway Archaeology in Wisconsin: The 1978 Field Season. State Historical Society of Wisconsin and Wisconsin Department of Transportation, Madison.
- Stoltman, James B. 1973. The Overhead Site (47 Lc 20), an Orr Phase Site Near La Crosse, Wisconsin. The Wisconsin Archeologist, 54(1):1-35.
- University of Wisconsin-La Crosse. 1975. State Road and Ebner Coulee, La Crosse Wisconsin Environmental Impact Statement, River Studies Center.

# INDEX, REFERENCES, AND APPENDIXES

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Comparative Impacts of Alternatives	pp. EIS 10-11, para. 3.12	pp. 27-102	
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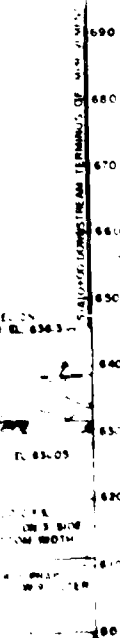
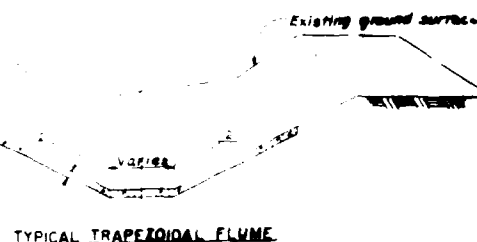
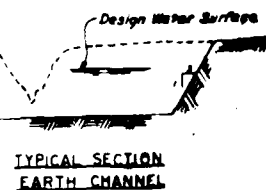
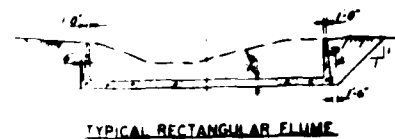


- LEGEND**
- DRAINAGE BOUNDARY
  - DAMS CONSIDERED BY CORPS OF ENGINEERS
  - DAMS CONSIDERED INITIALLY BY SOIL CONSERVATION SERVICE
  - ALIGNMENT OF PROPOSED IMPROVEMENTS
  - LA CROSSE CITY LIMITS

DESIGN MEMORANDUM NO. 1  
 GENERAL PHASE I PLAN FORMATION  
 FLOOD CONTROL  
 STATE ROAD AND EIDER COULEE  
 LA CROSSE, WISCONSIN  
 AUTHORIZED PLAN OF IMPROVEMENTS  
 BY PAUL W. H. DISTRICT  
 FILE NO.

SCALE 1" = 1/2 MILE





DESIGN MEMORANDUM NO.

GENERAL	PHASE	PLAN	FORMULATION
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1. ROAD CONTROL

STATE ROAD AND EBNER COLLEES

LA CROSSE, WISCONSIN

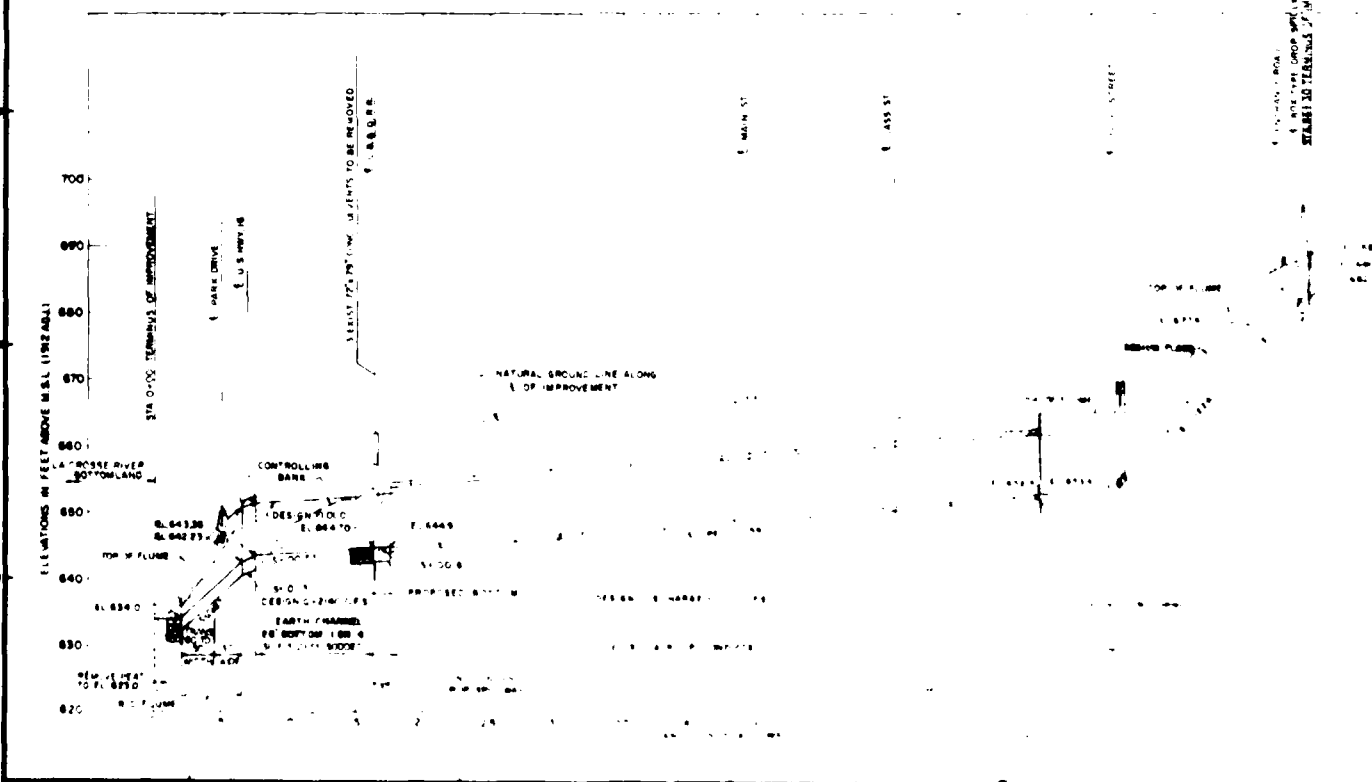
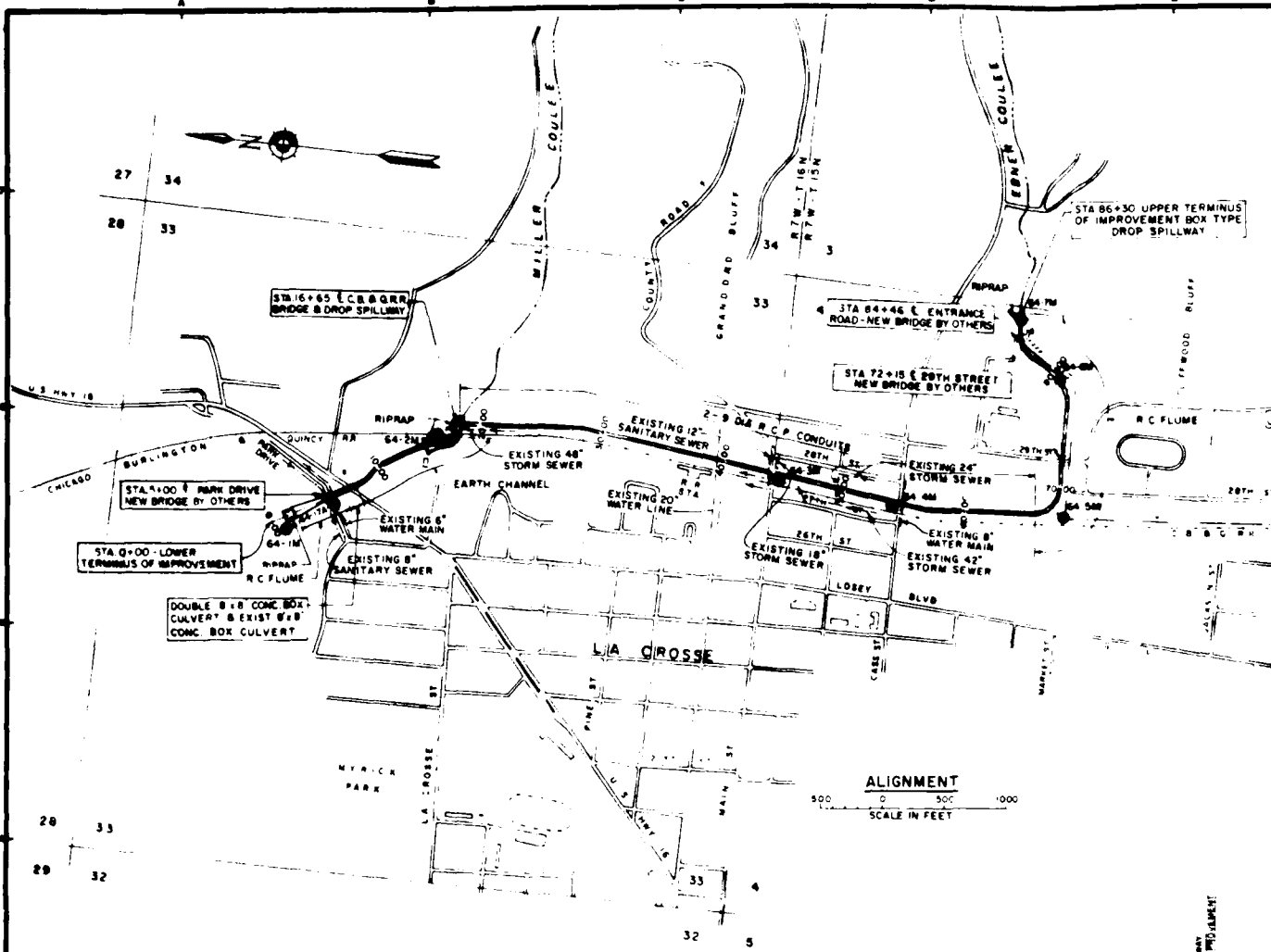
STATE ROAD COLLEES

AUTHORIZED CHANNEL IMPROVEMENT

ALIGNMENT B PROFILE

APRIL 1958

1. PLAN





AD-A120 480

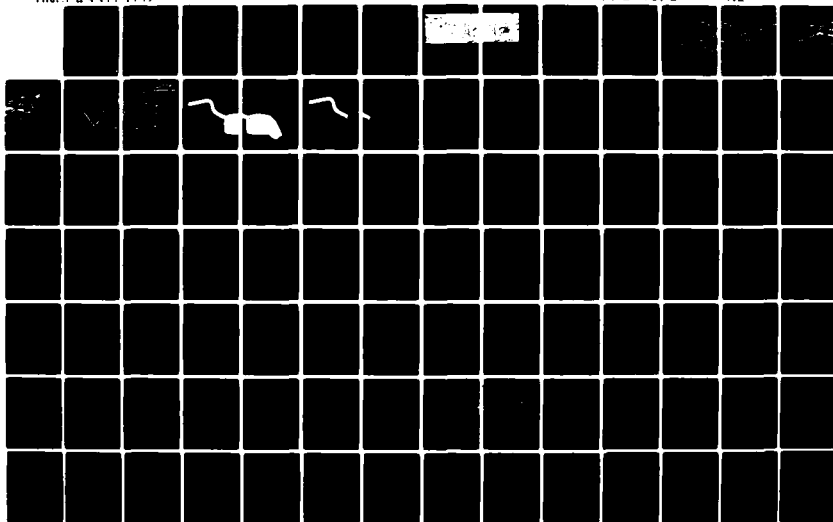
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WISCONSIN GENERAL DE... (U) CORPS OF ENGINEERS ST PAUL MN  
ST PAUL DISTRICT APR 82

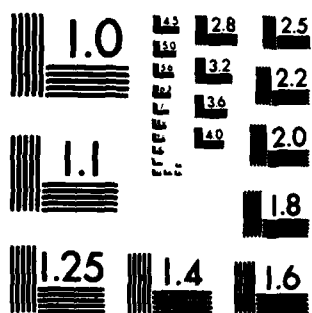
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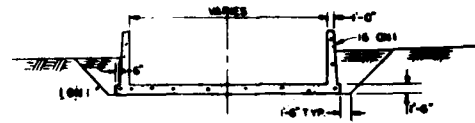
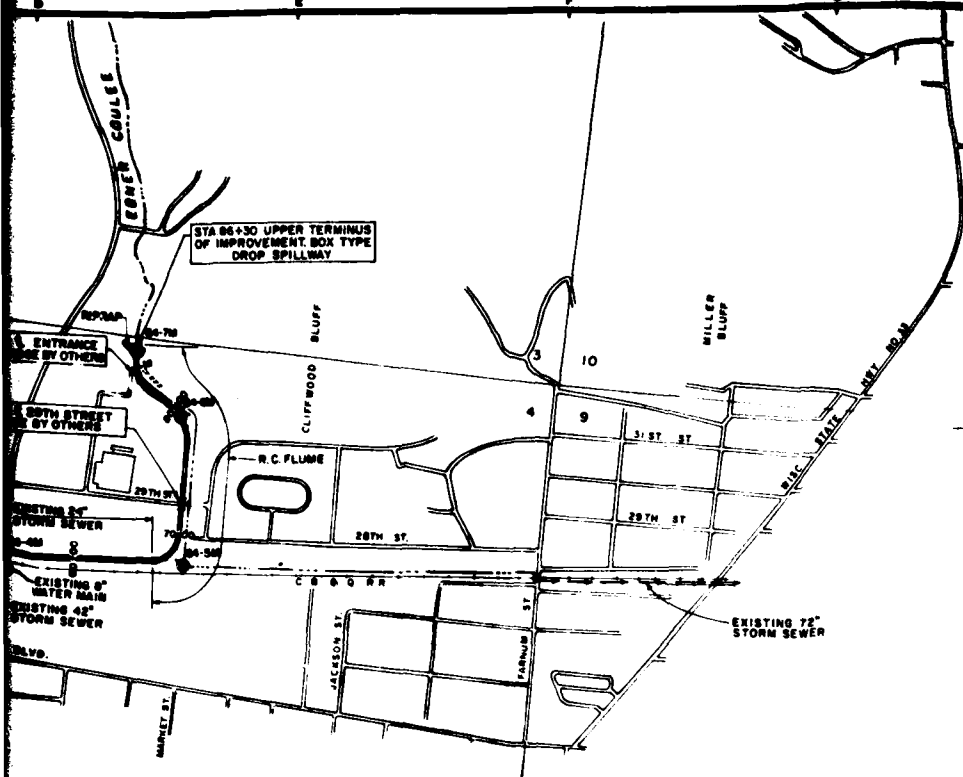
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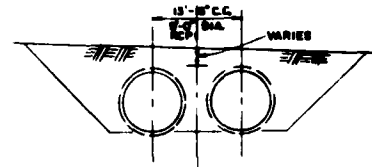




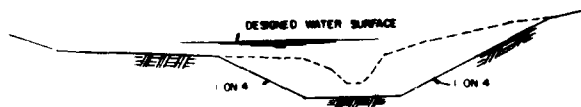
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NATIONAL BUREAU OF STANDARDS-1963-A



RECTANGULAR FLUME  
TYPICAL SECTION

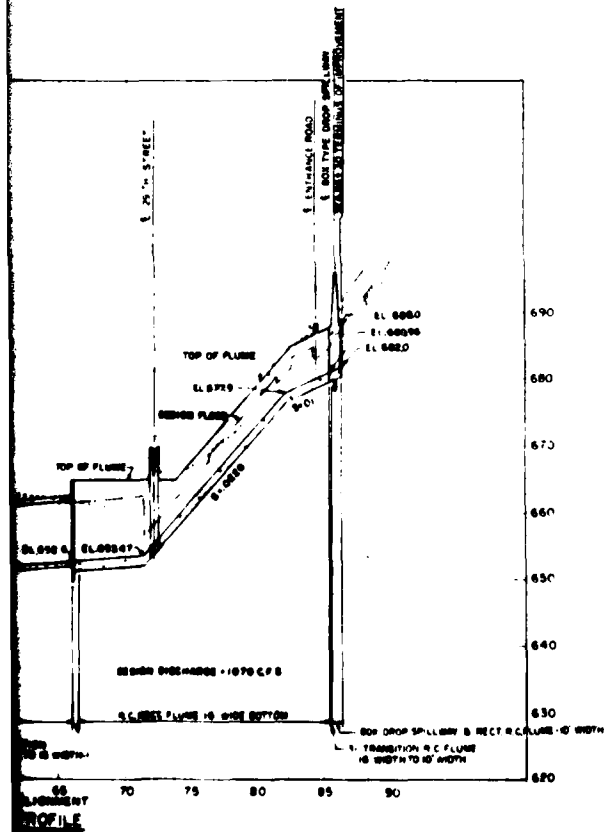


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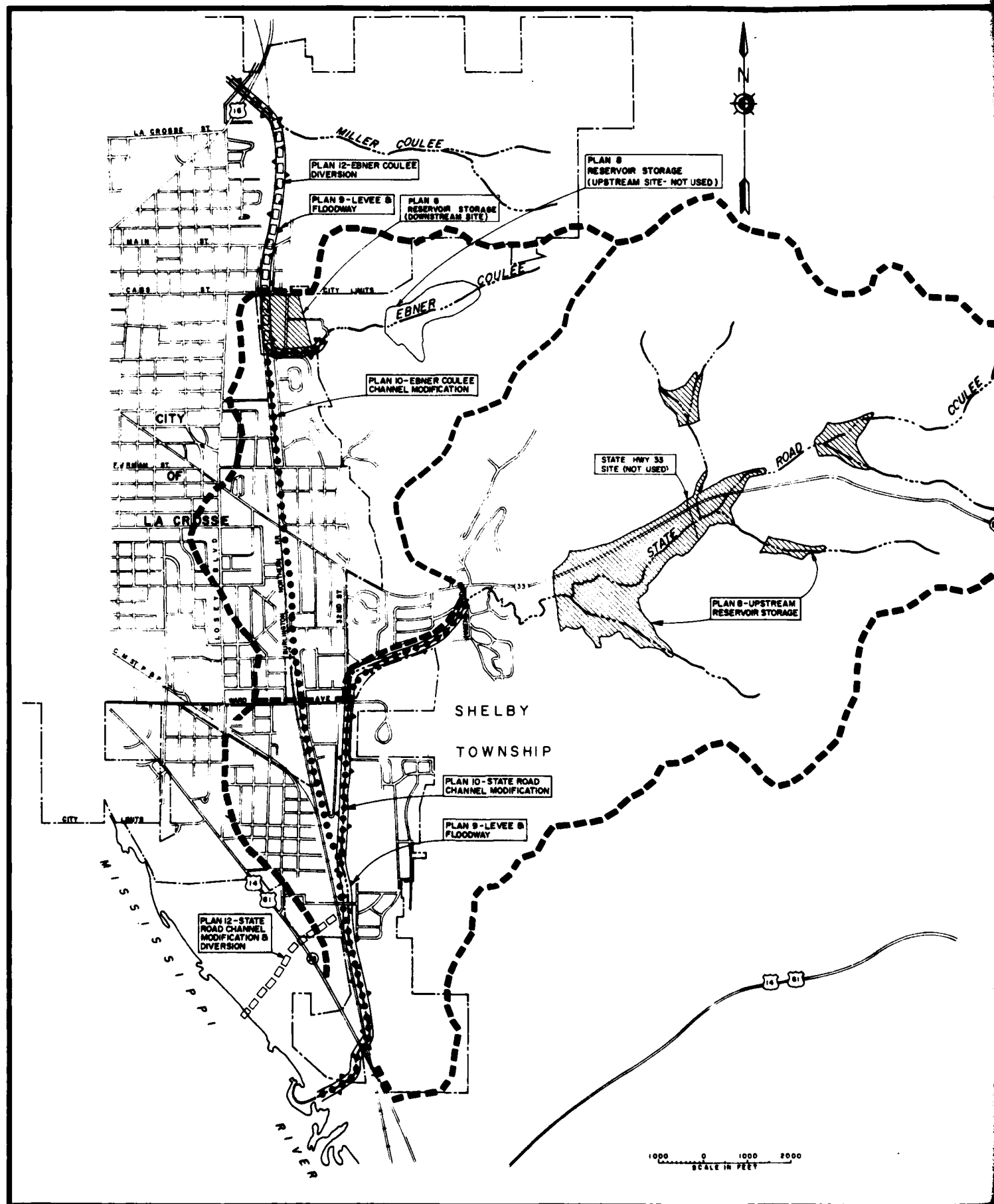


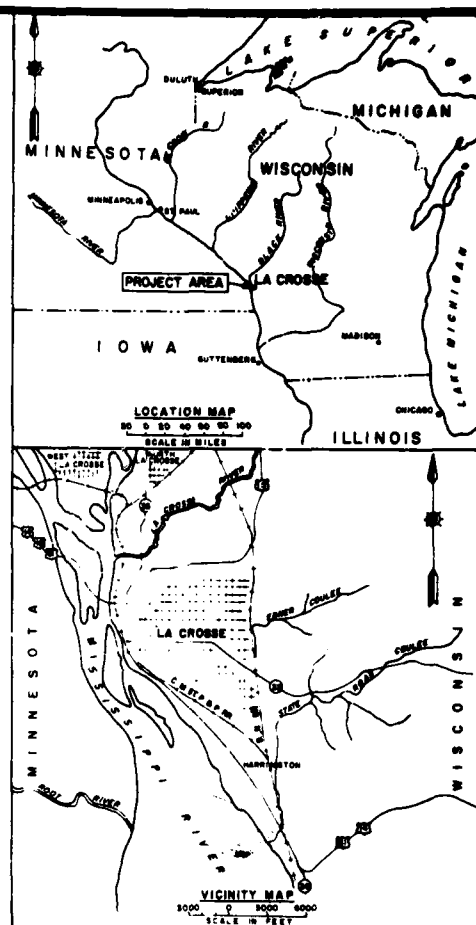
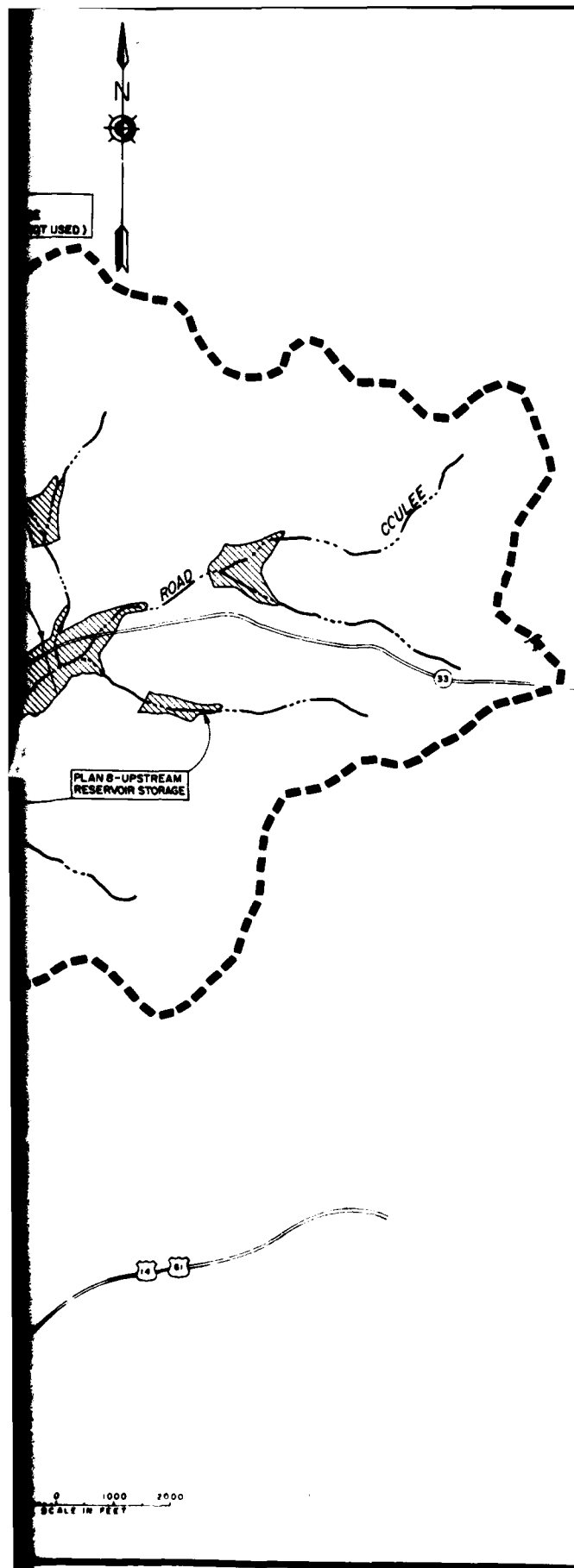
TYPICAL SECTION  
EARTH CHANNEL

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500 1000  
20 FEET



DESIGN MEMORANDUM NO. 1  
GENERAL PHASE I PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND EDNER COULEES  
LA CROSSE, WISCONSIN  
EDNER COULEE  
AUTHORIZED DIVERSION WORK  
ALIGNMENT & PROFILE  
ST. PAUL, MINN. DISTRICT  
FILE NO





# **LEGEND**

## **ALTERNATIVE PLANS CONSIDERED NON-STRUCTURAL ALTERNATIVES**

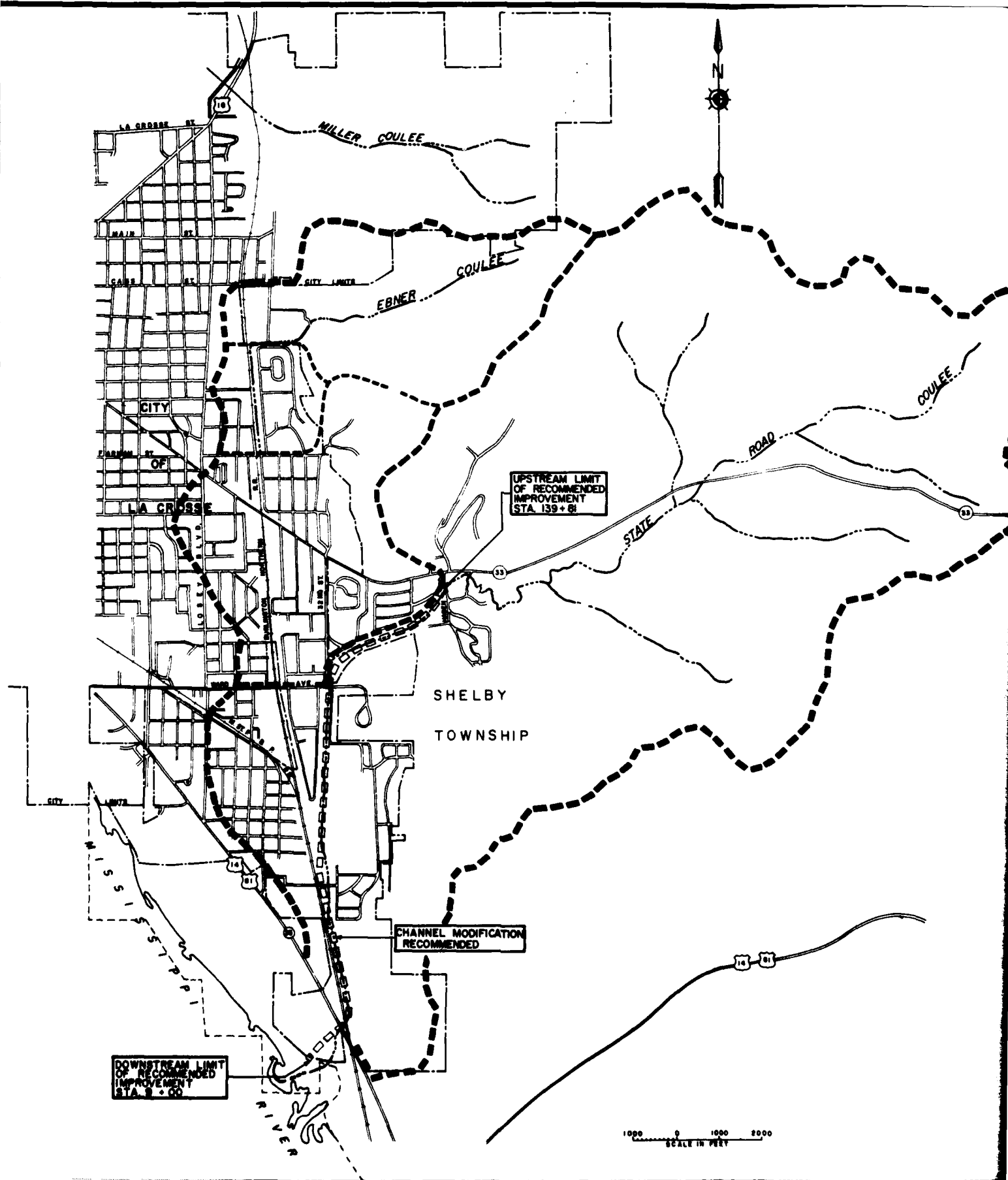
- PLAN 1 - FLOOD WARNINGS & EMERGENCY PROTECTION
- PLAN 2 - PERMANENT FLOODPLAIN EVACUATION
- PLAN 3 - FLOOD PROOFING
- PLAN 4 - FLOOD INSURANCE
- PLAN 5 - FLOODPLAIN REGULATION
- PLAN 6 - COMBINATION OF FLOODPLAIN EVACUATION, FLOOD PROOFING, & FLOODPLAIN REGULATION
- PLAN 7 - UPSTREAM LAND TREATMENT

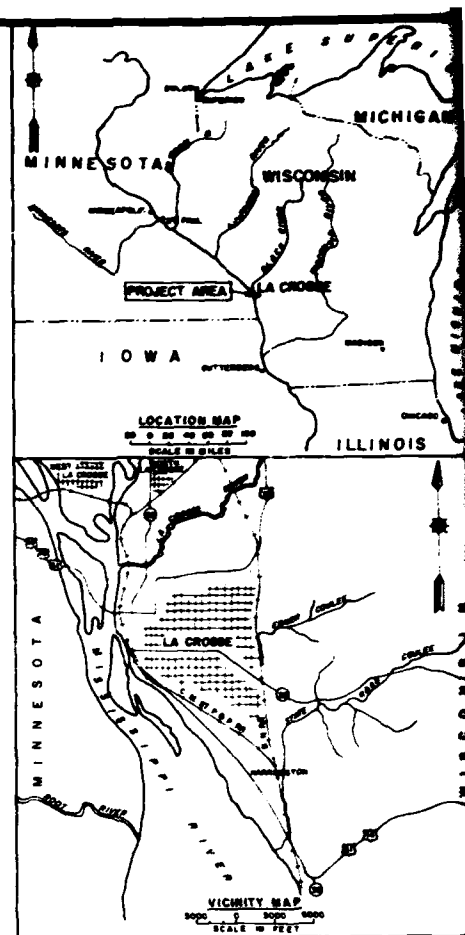
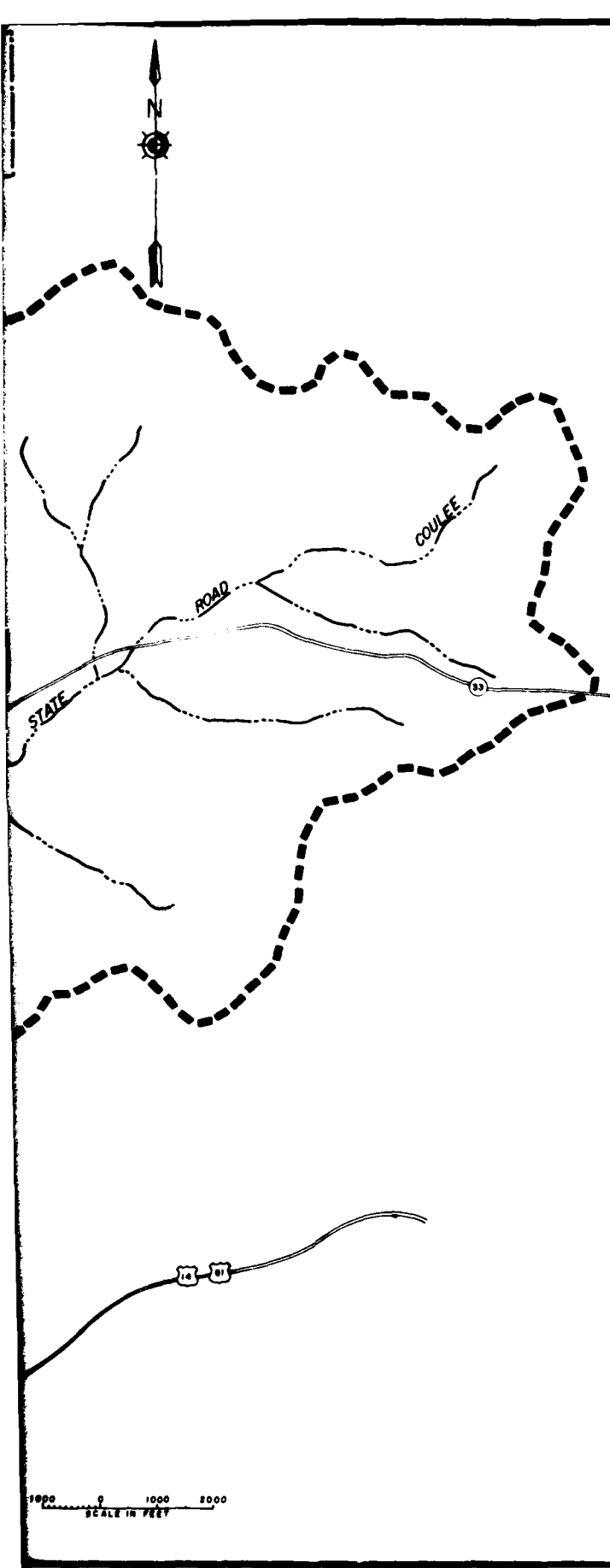
## **STRUCTURAL ALTERNATIVES**

- PLAN 8 - UPSTREAM RESERVOIR STORAGE
- PLAN 9 - LEVEE & FLOODWAY
- PLAN 10 - CHANNEL MODIFICATION
- PLAN 11 - RESERVOIR PLUS CHANNEL MODIFICATION
- PLAN 12 - CHANNEL MODIFICATION & DIVERSION

- ■ ■ ■ DRAINAGE BOUNDARY
- — — — LA CROSSE CITY LIMITS

DESIGN MEMORANDUM NO. 1  
GENERAL PHASE I - PLAN DEVELOPMENT  
FLOOD CONTROL  
STATE ROAD AND GIBER COULEE  
LA CROSSE, WISCONSIN  
  
ALTERNATIVE PLANS CONSIDERED  
  
ST. PAUL, MINN. DISTRICT  
FILE NO.





# **LEGEND**

- DRAINAGE BOUNDARY
- EBIER COULEE SUBBOUNDARY
- □ □ ALIGNMENT OF PROPOSED IMPROVEMENTS
- LA CROSSE CITY LIMITS
- UPPER MISSISSIPPI NWR BOUNDARY

REVISED APRIL 1980

DESIGN ENGINEERING NO. 1  
GENERAL PHASE I PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND EBIER COULEE  
LA CROSSE, WISCONSIN  
RECOMMENDED PLAN  
GENERAL

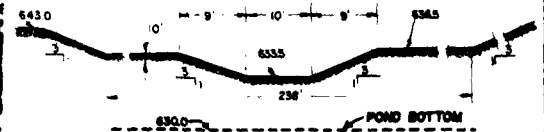
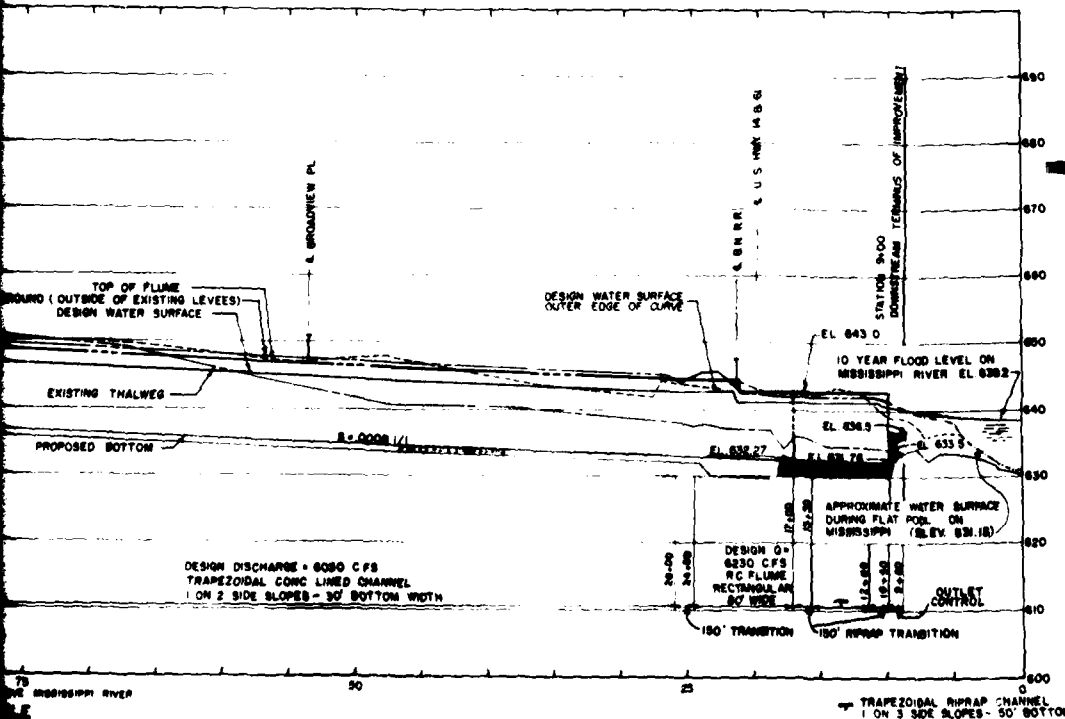
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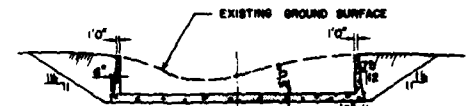
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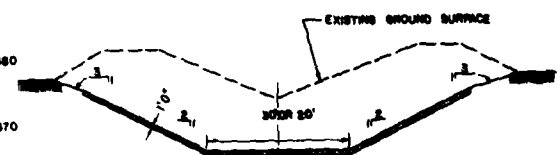
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TYPICAL SECTION  
RIPRAP CHANNEL



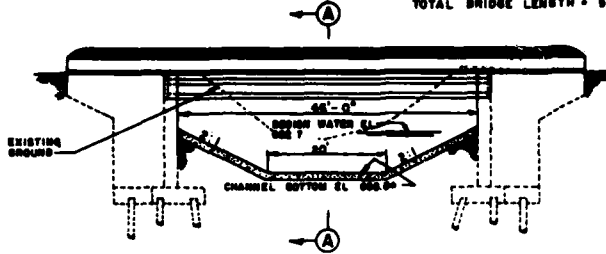
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(CONCRETE LINED)



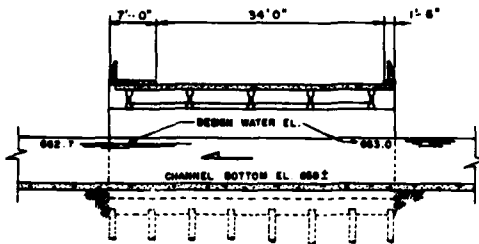
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(CONCRETE LINED)

DESIGN MEMORANDUM NO. 1  
GENERAL PHASE I PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND RIVER COULEE  
LA CROSSE, WISCONSIN  
STATE ROAD COULEE  
RECOMMENDED CHANNEL MODIFICATION  
ALIGNMENT & PROFILE  
BY PAUL W. H. DISTRICT  
PL 2 NO.

NOTE: EXISTING BRIDGE TO BE REMOVED  
DESCRIPTION: THREE SPAN BRIDGE WITH 37' WIDE TIMBER DECK  
SUPPORTED ON CONC. ABUTMENTS AND TIMBER PILE BENTS.  
TOTAL BRIDGE LENGTH = 90' 3"



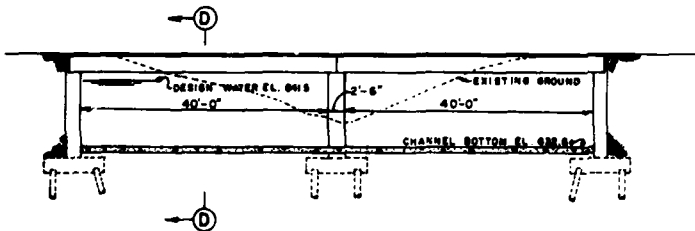
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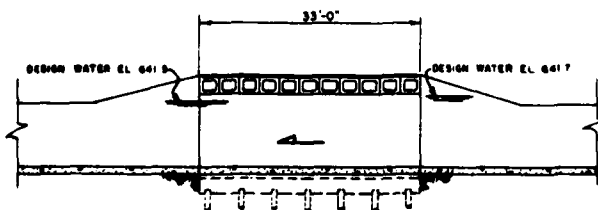
SECTION "A-A"  
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DRIVE-IN ROAD BRIDGE AT STA. 116 + 65

NOTE: EXISTING BRIDGE TO BE REMOVED  
DESCRIPTION: THREE SPAN CONC T-BEAMS SUPPORTED ON CONC ABUTMENTS,  
AND 15" Ø CONC PILE BENTS TOTAL BRIDGE LENGTH = 42' 5"

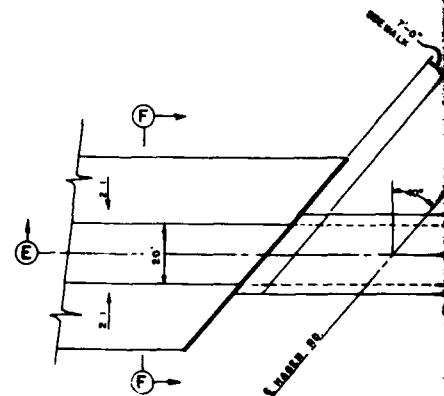


ELEVATION  
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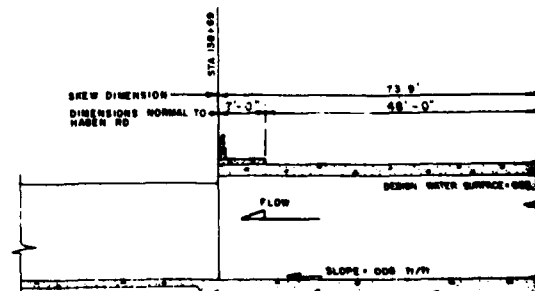


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B.N. RAILROAD BRIDGE AT STA. 21+46



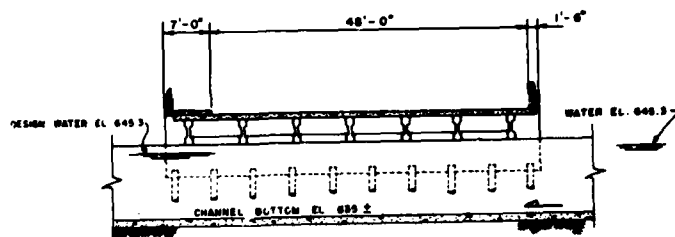
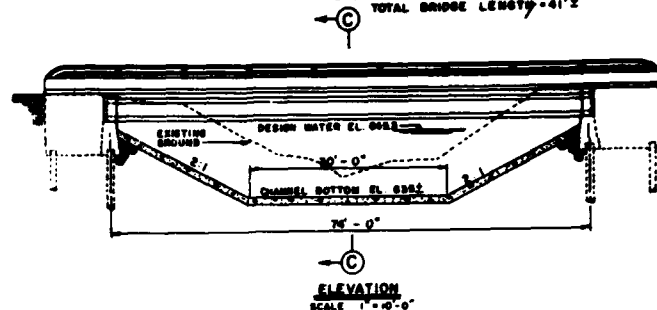
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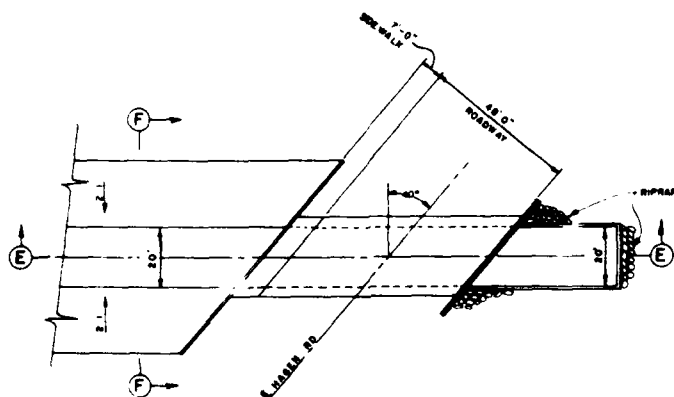
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DROP STRUCTURE AND HAGEN BRIDGE

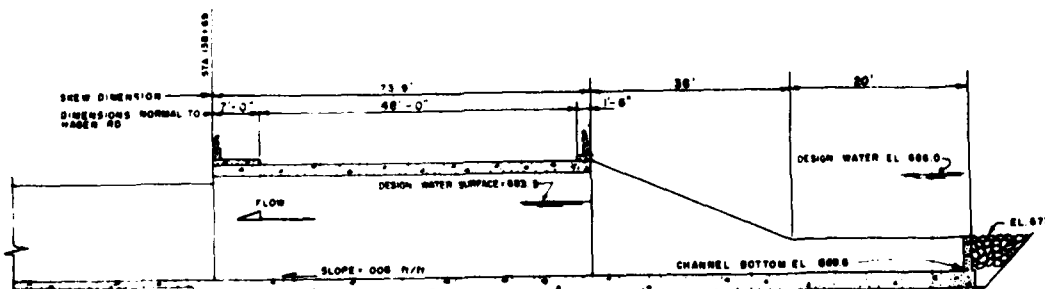
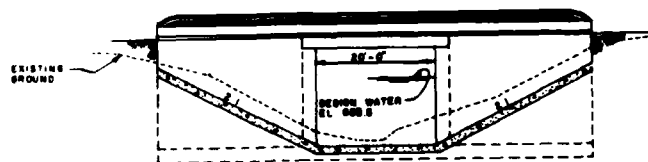
NOTE: EXISTING BRIDGE TO BE REMOVED  
DESCRIPTION: SINGLE SPAN BRIDGE WITH 30' WIDE TIMBER  
DECK AND 6x20" TIMBER BEAMS SUPPORTED ON TIMBER  
BACKED ABUTMENTS AND 12" Ø PILES  
TOTAL BRIDGE LENGTH = 41'2"



**BROADVIEW PLAZA BRIDGE AT STA 53+60**

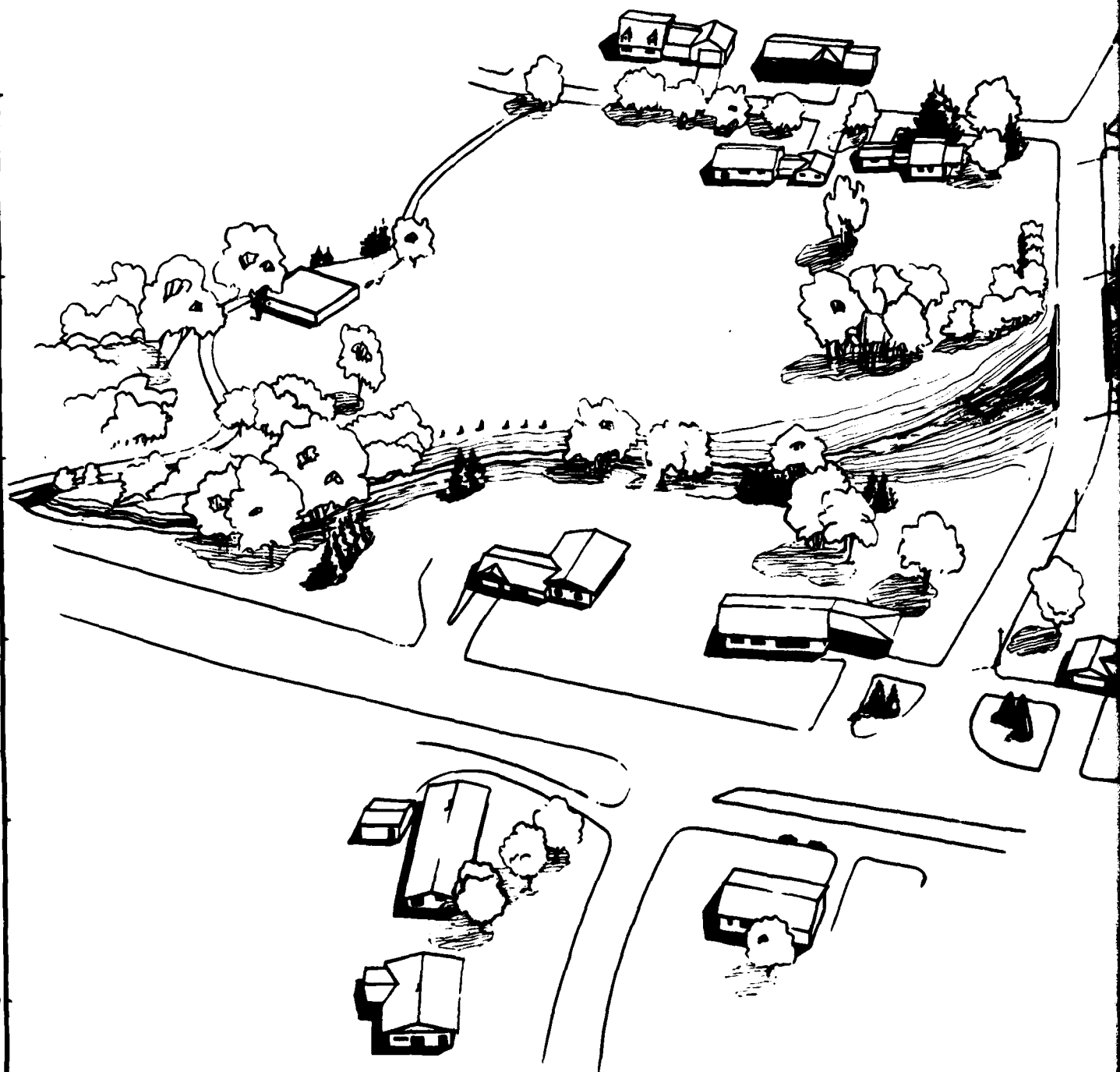


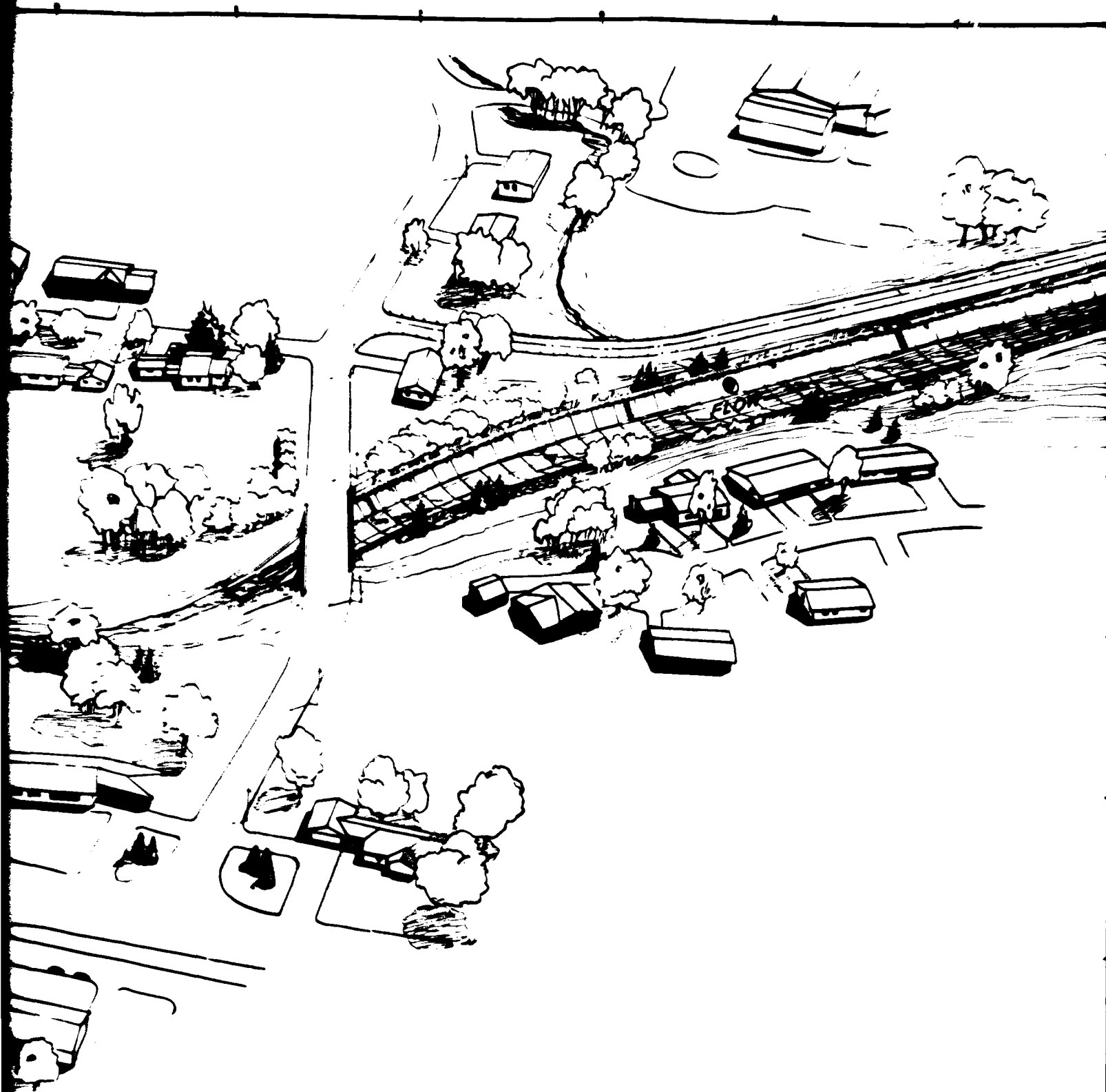
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DESCRIPTION: SINGLE SPAN BRIDGE WITH 18' WIDE CONC DECK AND  
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BACKED ABUTMENTS TOTAL BRIDGE LENGTH = 28'2"



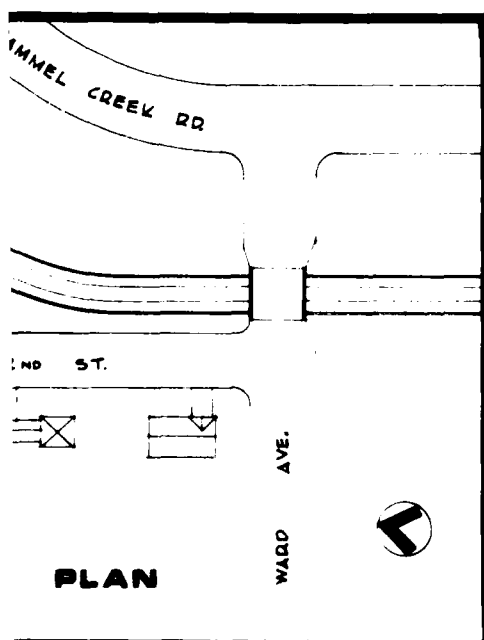
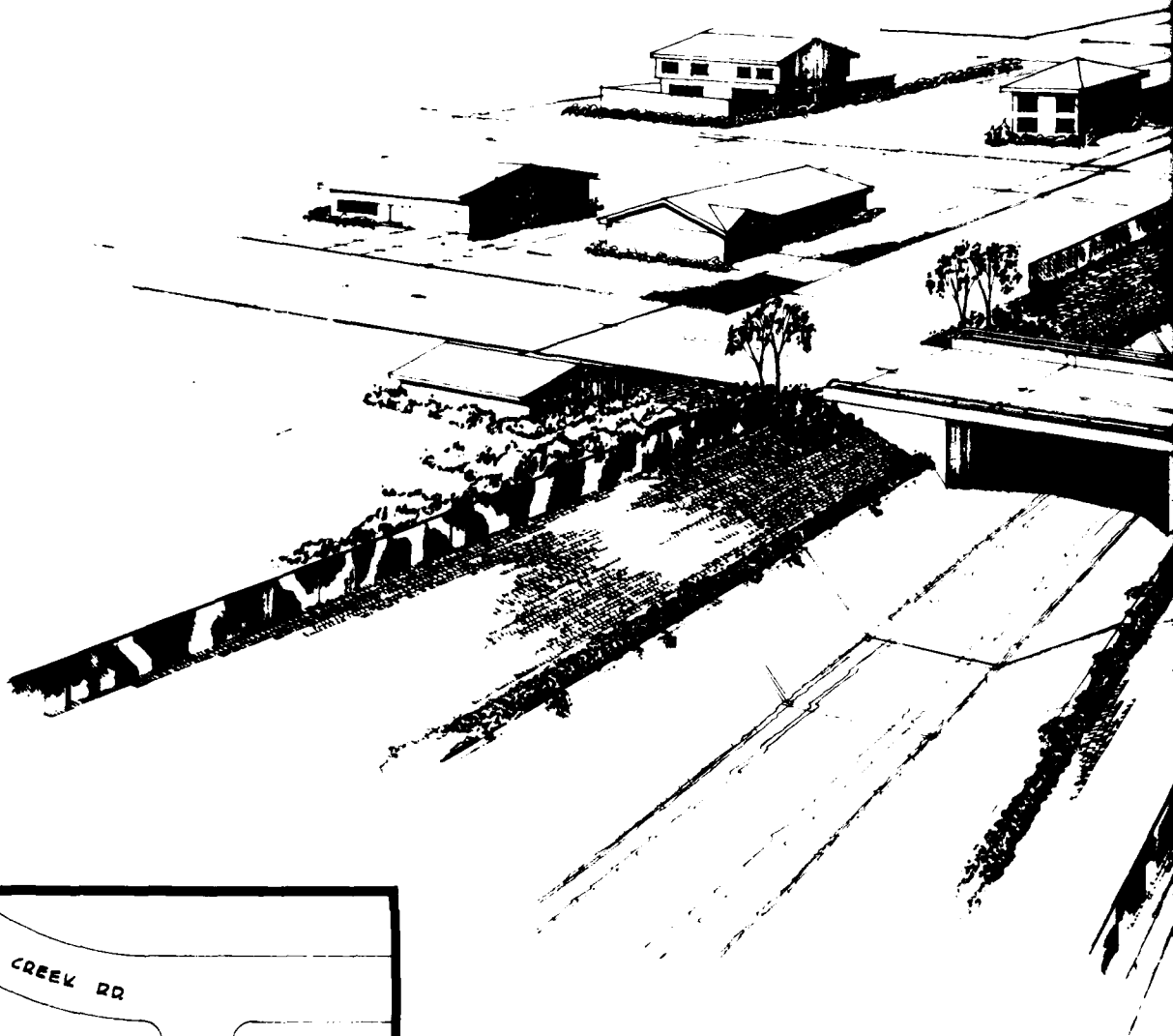
**DROP STRUCTURE AND HAGEN BRIDGE AT STA 139+69**

DESIGN MEMORANDUM NO. 1  
GENERAL PHASE I PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND RIVER COULEES  
LA CROSSE, WISCONSIN  
STATE ROAD COULEES  
RECOMMENDED BRIDGES  
ST. PAUL DISTRICT  
FILE NO.

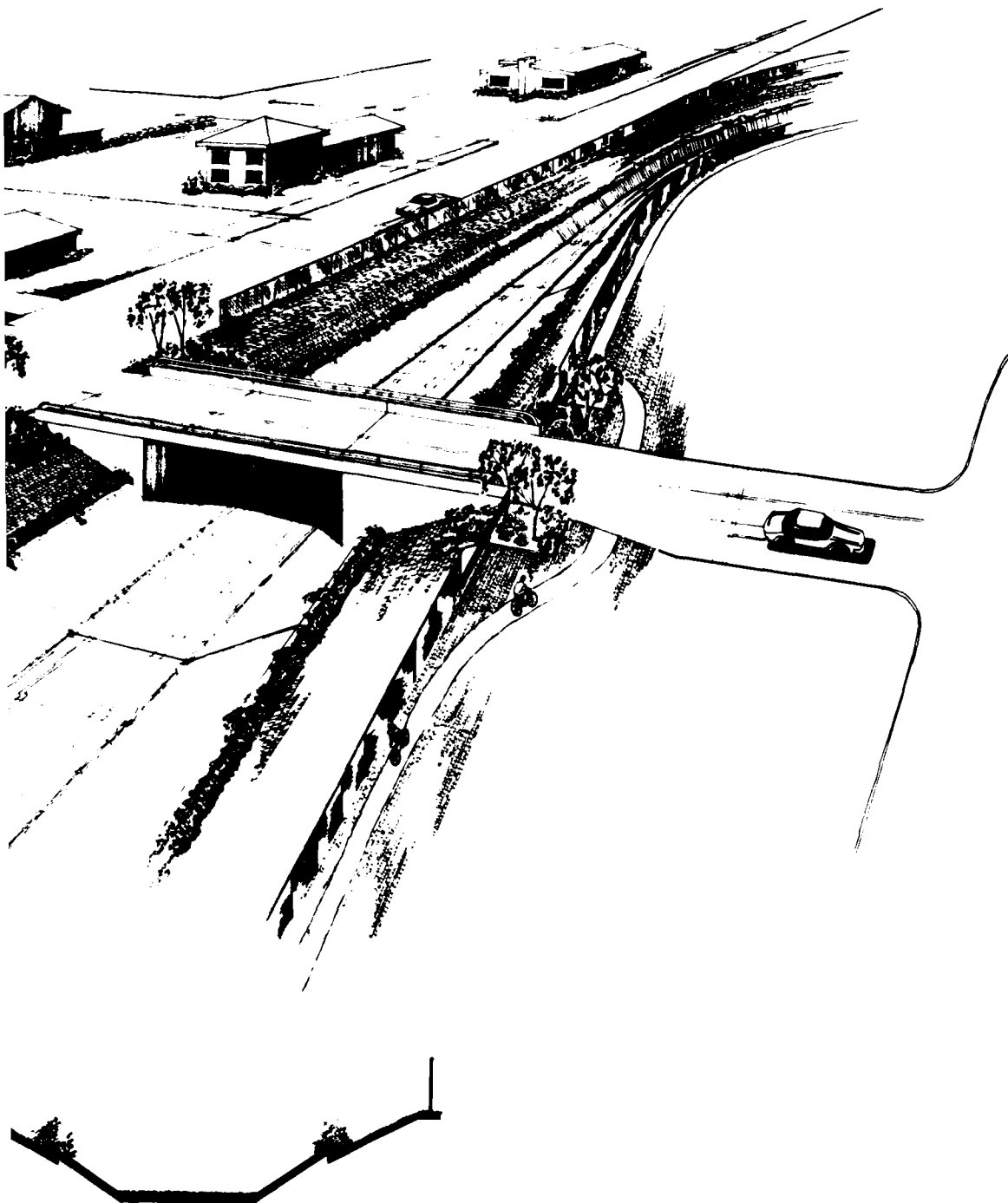




DESIGN MEMORANDUM NO. 1  
 GENERAL PHASE I PLAN FORMULATION  
 FLOOD CONTROL  
 STATE ROAD AND EBNER COULEES  
 LA CROSSE, WISCONSIN  
 STATE ROAD COULEE  
 RECOMMENDED CHANNEL MODIFICATION  
 CONCEPTUAL VIEW - HAGEN ROAD  
 UPSTREAM TERMINUS  
 ST. PAUL WARD DISTRICT  
 FILE NO.



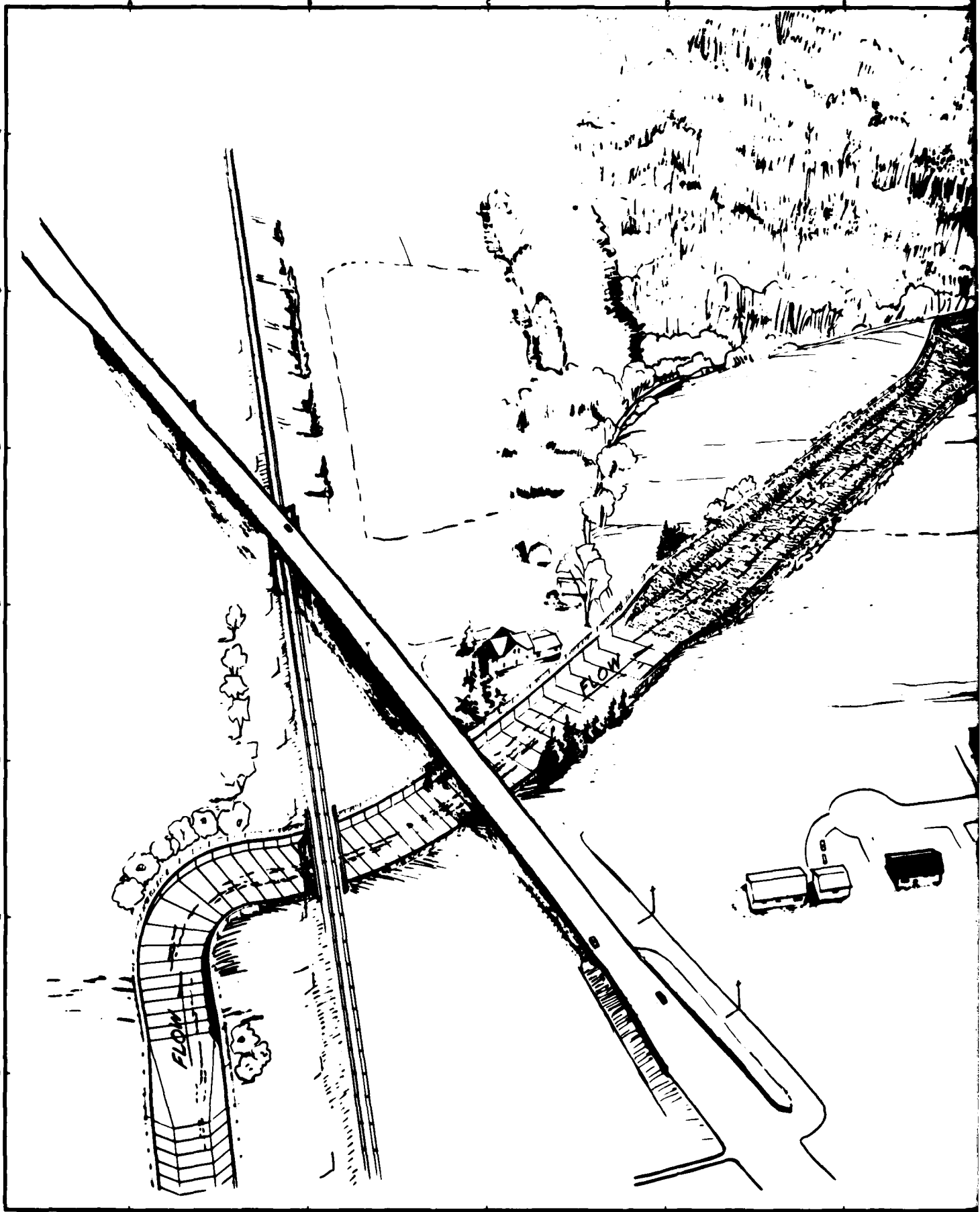
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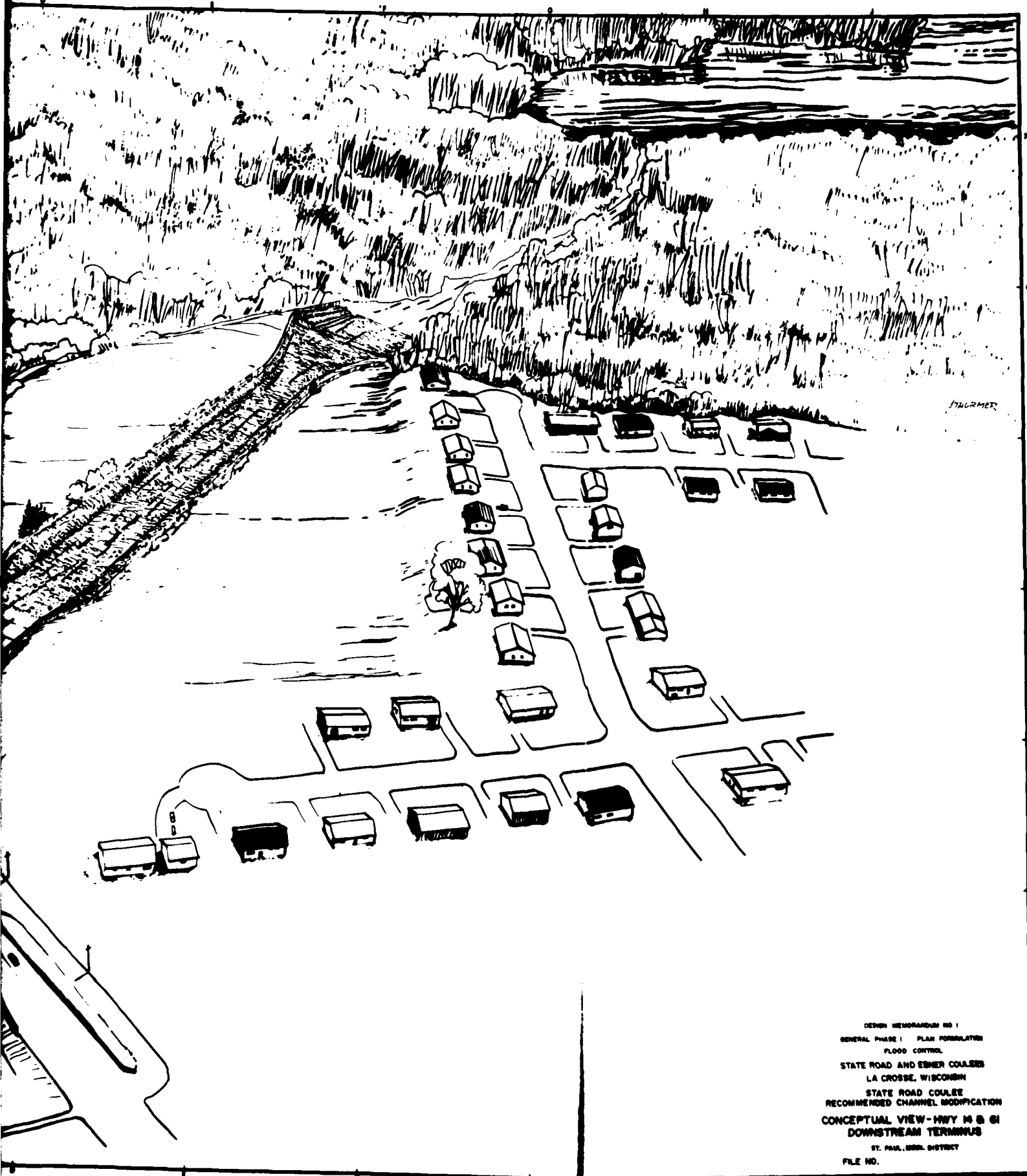
**LOSS SECTION**

DESIGN MEMORANDUM NO. 1  
 GENERAL PHASE I PLAN FORMULATION  
 FLOOD CONTROL  
 STATE ROAD AND EMMER COULEE  
 LA CROSSE, WISCONSIN  
 STATE ROAD COULEE  
 RECOMMENDED CHANNEL MODIFICATION  
 CONCEPTUAL VIEW - WARD AVE.

ST. PAUL BARR. DISTRICT  
 FILE NO.



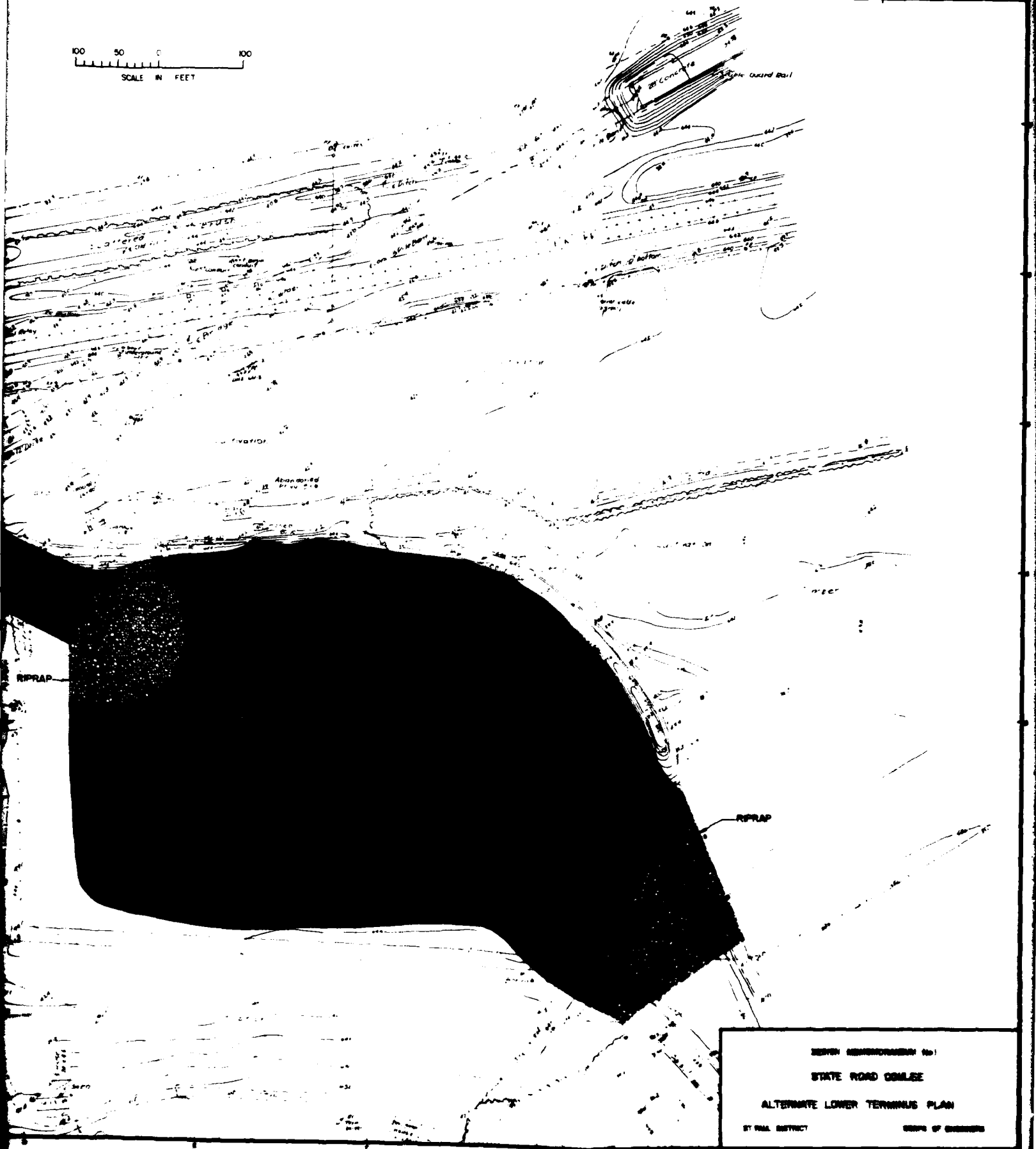




DESIGN MEMORANDUM NO. 1  
GENERAL PHASE I PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND EBMER COULEES  
LA CROSSE, WISCONSIN  
STATE ROAD COULEE  
RECOMMENDED CHANNEL MODIFICATION  
CONCEPTUAL VIEW - HWY 14 & 61  
DOWNSTREAM TERMINUS  
ST. PAUL, MINN. DISTRICT  
FILE NO.



100 50 0 100  
SCALE IN FEET



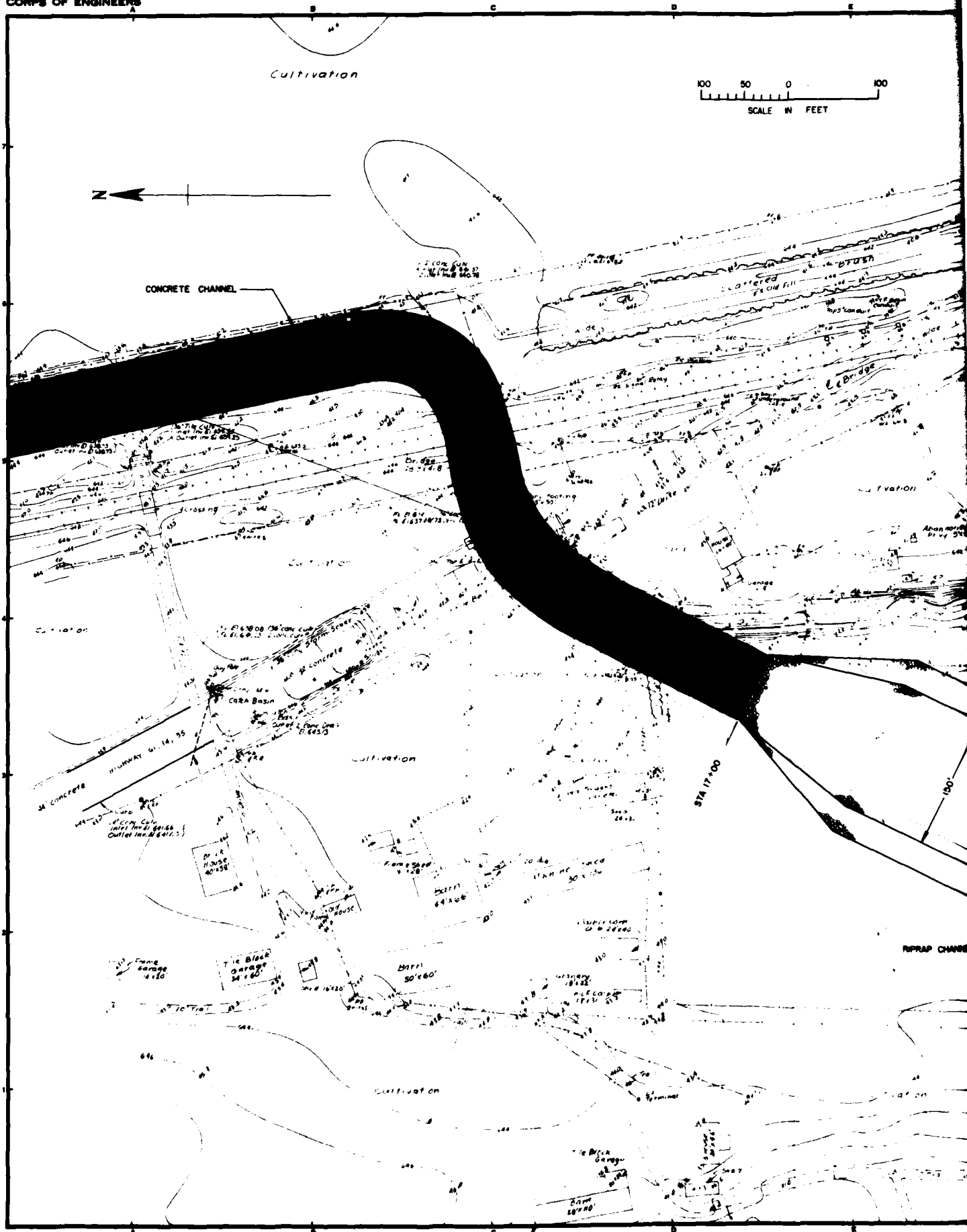
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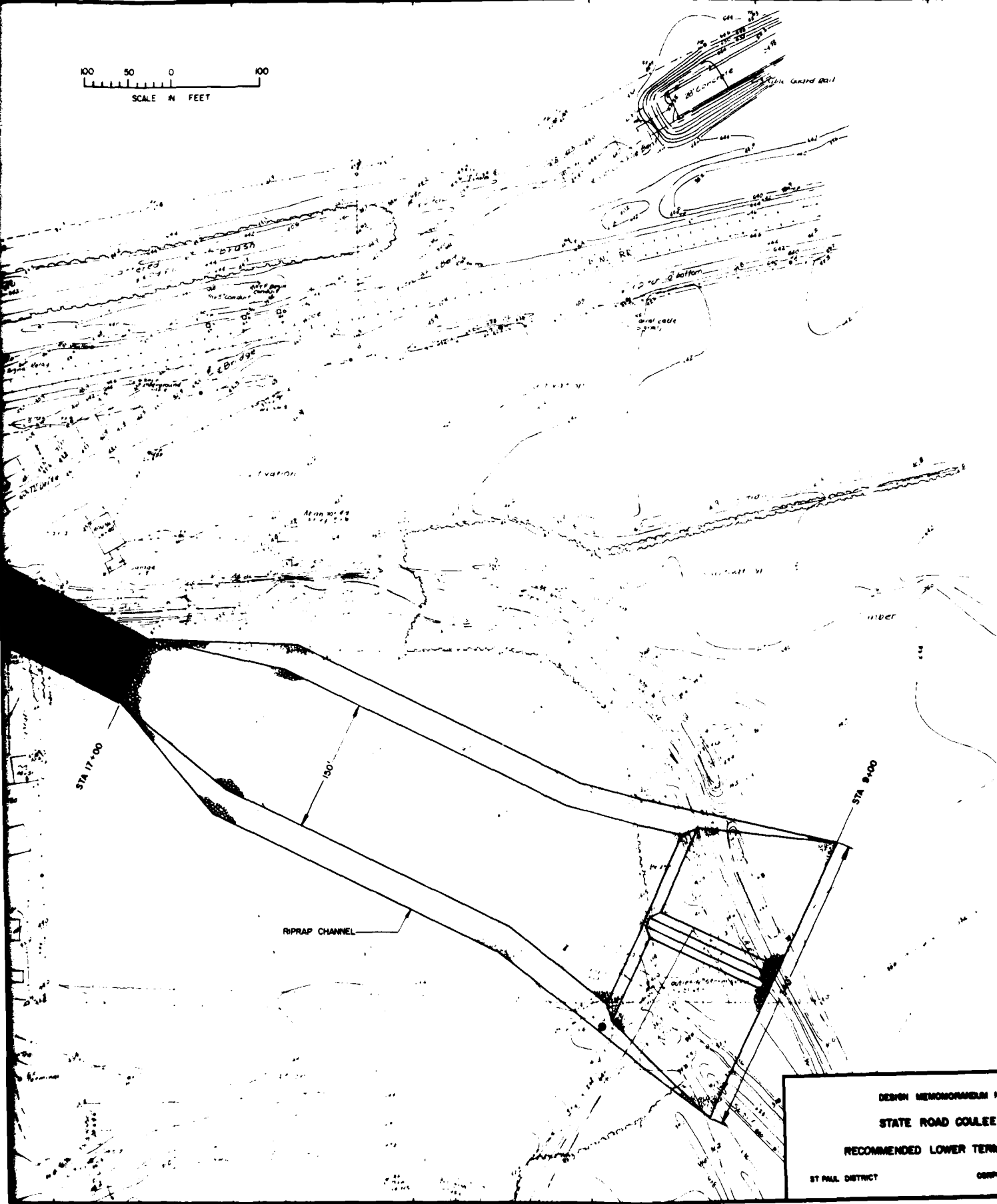
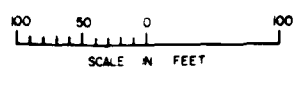
STATE ROAD COMLEE

ALTERNATE LOWER TERMINUS PLAN

ST. PAUL DISTRICT

GROUP OF ENGINEERS





DESIGN MEMORANDUM No 1  
STATE ROAD COULEE  
RECOMMENDED LOWER TERMINUS PLAN  
ST PAUL DISTRICT  
CORPS OF ENGINEERS

PUBLIC PARTICIPATION AND COORDINATION

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PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

PUBLIC PARTICIPATION AND COORDINATION

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2	NEWSPAPER CLIPPING, 17 APRIL 1975
3	NEWSPAPER CLIPPING
4	NEWSPAPER CLIPPING, 9 DECEMBER 1975
5	ANNOUNCEMENTS OF CITIZENS COMMITTEE MEETINGS, 30 OCTOBER 1974 AND 21 JANUARY 1975
6	MINUTES OF 25 SEPTEMBER 1975 CITIZENS COMMITTEE MEETING
7	MPMO FOR RECORD DESCRIBING 30 JANUARY 1975 CITIZENS COMMITTEE MEETING
8	STATE ROAD-EBNER COULEE FLOOD CONTROL COMMITTEE POSITION PAPER, 27 SEPTEMBER 1975
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## APPENDIX 1

### PUBLIC PARTICIPATION AND COORDINATION

#### PUBLIC PARTICIPATION

##### GENERAL

Public participation activities carried on during the studies for State Road and Ebner Coulees went through two separate stages. The first stage (1974-76) involved intensive contact with the State Road-Ebner Coulees Citizen Advisory Committee, which led to the development of a recommended plan and the November 1976 draft report. The second stage (1978-1980) involved updating the November 1976 draft report and resolving questions raised by agencies and private individuals. The second stage took longer than expected because of (1) delays in establishing the 10-, 50-, 100-, and 500-year flood insurance outlines and profiles; (2) time necessary to develop an acceptable environmental plan; and (3) other related problems.

##### CITIZENS ADVISORY COMMITTEE

At the initiation of phase I studies for State Road and Ebner Coulees, public participation in the study was recognized as a key element in evaluation of alternatives. Through the work of La Crosse County, a citizens advisory committee was formed on 25 June 1974. At that time, a committee of 10 persons was chosen to represent a broad range of interests and types of people; two more members were added in 1975. A list of members is contained in the following table.

Membership list, citizens advisory committee, State Road and Ebner  
Coulees (August 1975)

Name	Residence
James M. Brindley	Shelby Township, Wisconsin
LeRoy Brudos	Shelby Township, Wisconsin
Dr. Herold Classen (Committee Chairman)	Shelby Township, Wisconsin
James Cropper (SCS)	La Crosse, Wisconsin
Dorothy Dedo (Shelby Town Board)	Shelby Township, Wisconsin
Barbara Frank	Shelby Township, Wisconsin
Roger Horstman	La Crosse, Wisconsin
Sharon Imes (City Alderman)	La Crosse, Wisconsin
Al Mages (Committee Secretary)	Shelby Township, Wisconsin
Sarah Murphy	Shelby Township, Wisconsin
James Thornton	La Crosse, Wisconsin
John Zoerb	Shelby Township, Wisconsin

Citizens advisory committee meetings were open to the public as demonstrated by local news media coverage, the major portion of which was provided by area newspapers. Sample news articles concerning several of the meetings, including premeeting and postmeeting coverage, are illustrated in exhibits 1 through 4.

Announcements of upcoming meetings were printed in the newspapers, and all committee members as well as interested local, State, and Federal agencies received notices of the meetings. Those groups and/or agencies which demonstrated an interest in the study received regular meeting notices. Sample announcements are displayed in exhibit 5.

A total of 10 meetings of the citizens advisory committee was held over a 2-year period and covered a variety of project related issues. A list of meetings held, containing date, subject, and agency representatives, is shown in the following table.

Meetings with citizens advisory committee

<u>Date</u>	<u>Purpose</u>	<u>Representatives providing agenda input</u>
25 July 1974	Summarize authorized plan; Phase I plan formulation.	Corps - Northrup, Kumpula, Berry
7 August 1974	Tour of study area; Handouts describing author- ized study plan.	Corps - Kumpula, Berry
7 November 1974	Presentation of floodplain regulations and zoning information.	Wis. DNR - Mr. Jack Walsh La Crosse County Zoning Comm. - Mr. Ray Pelishek
30 January 1975	Current water resources pro- blems and needs; Plan formulation and evalua- tion criteria; Structural and nonstructural methods of alternative solutions.	Corps - Kumpula, H. John- son University of Wisconsin - La Crosse - Thomas Claflin, Doug Sweetland, Lawrence Daellenbach
16 April 1975	Discussion of channel modi- fication alternative align- ments; materials, rights- of-way, and first costs in- volved; handouts assessing social, economic, and en- vironmental impacts.	Corps - Kumpula, Munho- land Owen Ayres - Glen Tamke, Kevin Hagen, Jam Bakken
3 June 1975	Discussion of 12 alterna- tive solutions investigated.	Corps - Kumpula, Northrup
18 June 1975	Summary of alternative sol- utions investigated. Com- mittee adopts notion that further study of State Road Coulee be limited to channel modification.	Corps - Kumpula, Northrup
23 July 1975	Discussion of State Road Coulee channel modifica- tion impacts for various degrees of protection.	Corps - Kumpula, Munho- land
9 September 1975	Discussion of updated sum- maries of Ebner Coulee al- ternatives.	Corps - Kumpula
25 September 1975	Position paper - channel modification recommended for State Road Coulee, no action recommended for Ebner Coulee.	Corps - Kumpula, Northrup

h some of the meetings addressed flood reduction alternatives  
ne coulee, the postpresentation discussion generally included  
Road and Ebner Coulees.

es of each meeting were prepared and made available for public  
sample of these minutes is illustrated in exhibit 6. (Minutes  
eetings can be obtained by contacting the St. Paul District office.)  
um for record was also prepared for each meeting as is shown by  
(These are also available at the St. Paul District office.)

d the conclusion of the citizens advisory committee meetings  
rst stage of phase I studies, a position paper was adopted by  
s to express their views and opinions on the State Road and Ebner  
oject. A copy of the position paper is included as exhibit 8.

#### COORDINATION

ination was maintained with interested local, State, and Federal  
uring the phase I general design memorandum studies from 1974 to  
itizens advisory committee was formed for the study by the local  
a Crosse County. Two other local units of government were also  
d on the committee - the city of La Crosse and the township of  
etters were sent to the State and Federal agencies listed on the  
table to advise them of the initiation of postauthorization  
ctivities, stating the purpose of these studies, requesting  
ews of the authorized project, and indicating the formation of  
ns advisory committee to review and comment on the investigations.  
the letter is included as exhibit 9.

Coordination list, State and Federal agencies	
Agency	Location
Regional Director U.S. Fish and Wildlife Service	Twin Cities, Minnesota
Regional Director U.S. Department of Health, Education, and Welfare	Chicago, Illinois
Regional Director Environmental Protection Agency	Chicago, Illinois
Regional Administrator Federal Highway Administration	Homewood, Illinois
Secretary Wisconsin Department of Natural Resources	Madison, Wisconsin
State Highway Engineer Wisconsin Department of Transportation	Madison, Wisconsin
Wisconsin State Historical Society	Madison, Wisconsin
Floodplain-Shoreland Management Section Wisconsin Department of Natural Resources	Madison, Wisconsin

The Wisconsin Department of Natural Resources and the Soil Conservation Service were represented at most of the citizens advisory committee meetings.

#### LOCAL COOPERATION

Local cooperation requirements for implementation of the authorized flood control plan, or a modification thereof, include provision of lands, easements, and rights-of-way as well as relocation of structures and utilities. In a resolution accompanying the 1967 survey report, La Crosse County indicated a willingness and intent to provide the items of local cooperation. Further assurances were requested and received from La Crosse County in a statement dated 10 November 1969. Following a flood on Ebner Coulee on 11 June 1973, a resolution was adopted by

the city of La Crosse in July 1973 supporting appropriation of funds for the project and expressing willingness to participate financially in the local costs of the project. Area interests became concerned with the amount of local costs after the 1975 phase I studies had progressed to the point where current local costs were under evaluation for alternative solutions.

Continued county sponsorship was also contingent upon the resolution regarding distribution of local cost sharing between La Crosse County, Shelby Township, and the city of La Crosse. The county, in response to a 26 July 1976 request for an indication of continued sponsorship, declined to take any action in the near future. A copy of the letter to the county is included as exhibit 10. A copy of the county's response and attachments is included as exhibit 11.

#### NOVEMBER 1976 REPORT

Lack of local support for the recommended plan halted planning by the St. Paul District at a critical study stage. The efforts up until that time were summarized in a draft phase I report, which was sent to previously listed agencies and individuals for information but did not require comment.

#### RENEWED SUPPORT

Because of the lack of local support, the St. Paul District recommended that the State Road Ebner Coulee project be classified "inactive" in December 1976. However, the Chief of Engineers took no action on the recommendation and, after a flood in July 1978, local interests renewed their support for the proposed project. (Resolutions of renewed local interest dated 10 and 13 July and 17 August 1978 are shown in exhibit 12.)

## CURRENT STUDY

Coordination for the current study involved telephone contacts, letters, and several meetings with local, State, and Federal interests. The current study effort was initiated in FY 1979 with a token funding amount, but was delayed by the need first to reestablish the 100-year floodplain outline in an ongoing flood insurance study. Study direction received from higher authority in April 1979 was to update the November 1976 draft report using the current interest rate instead of the authorized project's 3 1/4-percent rate.

Meetings with local interests held after completion of the 1976 draft report are shown below:

Meetings with local interests		
Date	Purpose	Attendance
31 May 1978	Project review from authorization to date	La Crosse Area Planning Committee
5 June 1979	Project status	La Crosse city officials
11 Apr 1980	Environmental scoping meeting and project briefing	Federal, State, and local interests
23 Sept 1980	Environmental scoping and alternative review	Wisconsin Department of Natural Resources and U.S. Fish and Wildlife Service (other agencies were invited)
21 Oct 1980	Project status and recommended plan	La Crosse city officials and interested citizens
2 Feb 1981	Project schedule, funding, and possible emergency or interim activities	La Crosse city officials and interested agencies

Exhibits 13 and 14 illustrate the District's public notice on the proposed environmental scoping process and a typical response. The 11 April 1980 meeting listed above was held in La Crosse in view of responses and interest in an informational meeting on the project. Note that the scoping process was directed toward the State Road portion of the project since the Ebner Coulee part was not economically justified.

The U.S. Fish and Wildlife Service's stage 2 report dated 5 November 1980 is included as exhibit 15. This report was prepared in accordance with the Fish and Wildlife Coordination Act. The report summarizes the Service's evaluation of the proposed project impacts on fish and wildlife resources. It also evaluates several other project alternatives.

Exhibit 16 describes actions the city of La Crosse is taking on its own to resolve the Ebner Coulee flood problem. This action was precipitated by the finding that the Corps study was unable to arrive at a cost-effective 100-year protection plan for Ebner Coulee. The State Road Coulee channel would have to be 10 feet wider downstream from Broadview place to handle the added flow from Ebner Coulee under the city's proposal.



## Report Given On Projects To Control Floods

### Ebner Flood Plan To Be Reviewed

Stanley Kumpula of the St. Paul office of the Army Corps of Engineers will present a progress report on updating the Corps' 1967 plan for State Road-Ebner Coulee flood control at 7:00 p.m. Thursday in Room 207, La Crosse County Courthouse.

Thomas Clafin of the University of Wisconsin-La Crosse will give a summary of environmental impact studies in the watershed.

Douglas Sweetland and Lawrence Duellenbach of UW-L will summarize the findings of their economic analysis for the environmental impact statement.

The meeting is public.

A citizens committee got a progress report last night on planning for the State Road and Ebner Coulee flood control projects.

The Army Corps of Engineers, which is in the process of updating a 1969 plan of flood protection for the two watersheds, sent two representatives — Stanley Kumpula and Helmer Johnson — to the meeting.

Kumpula presented the citizens committee with a preliminary updated plan, one with some data missing, including the critical item of estimated costs. Committee members are to study the preliminary plan between now and the next meeting.

The 1969 plan the corps favored consisted of providing concrete channels for the streams — Ebner and Pammel creeks — which drain the two coulees.

Kumpula said, however, that in the process of updating the plans, all the possible alternatives would be considered again.

Johnson provided information on water-flow statistics on which the flood control plans will be based.

The committee was informed

that economic data on which cost-benefit ratios of the projects will be determined should be completed in a week or two.

Kumpula said that the nation, providing all agencies involved (local as well as federal), agree on a plan, is that construction would begin during fiscal years 1978 or 1979.

Thomas Clafin, University of Wisconsin-La Crosse biology professor, told the committee that it appears the environmental impact of the projects would be "minimal."

Clafin reported on a study being conducted by UW-L staff and students.

The main impact, he said, would appear to be on vegetation, particularly on 1,000 or so mature trees lining more-or-less south of Sherwood Manor Addition.

# Ebner-State Flood Control Is Outlined

By MARYBETH CLARK  
Tribune Correspondent

It could cost between \$19 million and \$28 million to protect the Ebner and State Road Coulees from that "once-in-a-hundred-years flood," according to engineering estimates.

A citizens advisory committee last night heard Stan Kumpula, Army Corps of Engineers, outline two of possibly 12 alternative plans to control periodic flooding in the two areas.

The last time the existing channels could not contain the swollen waters is believed to be 1972 when "damage was minor," says Kumpula. Prior to 1972, it was 1939 when the area flooded after five inches of rain fell in a single night.

However, flood control systems are built to provide protection from flood flows which have about a one-per-cent chance of occurring during a single year, Kumpula explained.

One plan, based on one "authorized" by the Army Corps of Engineers in 1968, provides for diverting water flows from the base of Ebner Coulee northward to a junction with the water from Miner Coulee and on to the Myrick marsh adjacent to the La Crosse River.

The second part of the plan calls for modification (enlargement) of the existing State Road Coulee channel which begins in the vicinity of Hagen Bridge, runs south parallel with the Burlington Northern Railroad tracks to the Mississippi River pool.

Costs for the "authorized" plan range from \$11.2 million to \$15.7 million depending on the type of construction and design.

There are three possibilities:

1. Consists of concrete-lined open channels, earth channel, and underground conduits for Ebner Coulee routed northward to the marshlands. Also consists of concrete-lined open channels for State Road Coulee routed southward to Mississippi River.

Of the \$15.7 million cost, the federal government would absorb \$17 million. Local sources would pay the remainder.

2. Essentially the plan No. 1 except that it provides for a more direct route for the State Road Coulee channel to reach the Mississippi River.

Of the \$23.5 million cost, the federal government would pay \$18.4 million.

3. Concrete-lined open

See FLOOD, P. 2

## Flood

Continued from Page 1

channels, earth channel and underground conduits for Ebner Coulee routed northward to the marshland of the La Crosse River. Also includes concrete lined open channels and an earth-lined channel for State Road Coulee routed southward to the Mississippi River.

Of the \$19 million cost, the federal government would pay \$15.7 million.

Under a second plan outlined for the committee, existing channels for both Ebner and State Road Coulees would be enlarged and deepened. Presently, the water flow from Ebner Coulee travels south to enter the City of La Crosse storm sewer system at Farnam Street, joins water from State Road Coulee and empties into the Mississippi River pool.

Costs for enlarging the 72-inch channel range from \$11.3 million to \$16.8 million with the federal government absorbing from half to six sevenths of the total first costs depending on the type of construction.

Engineering firm in charge of cost estimates for the Corps is Owen Ayres and Associates, Eau Claire.

Under the "authorized" plan from two to 15 homes would have to be relocated, while under the second plan from 10 to 157 homes would have to be relocated.

Kumpula estimates that about \$100,000 has already been spent on authorization studies for the project.

Alternatives still to be considered by the corps include: flood warning and emergency protection, flood proofing, floodplain eviction, upstream land treatment, levee and floodway system and channel modification plus upstream reservoirs.

# Flood Control Plans Selected

The State Road-Ebner Coulee Flood Control Citizens' Committee last night selected initial plans for the two areas costing a total of \$18.57 million, \$2.78 million of which would have to be paid by the local governments.

The committee also chose a second site for the Ebner Coulee area and ordered further study by the Army Corps of Engineers. This plan would use storage reservoirs to impede any possibility of flooding.

Dr. Cameron Gundersen, a committee member, suggested that the reservoir be placed further downstream from the site

selected by the Army engineers. Study of the sites for possible flood control improvements have been underway for 13 years. A final plan must be turned into corps headquarters in Washington by January, according to Stanley R. Kumpula of the corps.

Robert Northrup, another corps representative, admitted that the project is "two to three months behind."

Committee Chairman Harold Classen said the project is "at the most critical stage."

The single plan favored by the committee for the State Road

coulee is called channel modification and would entail deepening the stream bed and possibly making it concrete, either closed or open. Kumpula told the committee. When the committee next meets on July 7, he said the corps will have more specific suggestions for the project.

The committee indicated it favored a channel modification and diversion plan for Ebner's Coulee. This would rechannel part of the stream north along the railroad tracks into the marsh.

But the committee also told

the corps representatives to study the storage reservoir proposal and report back to the committee in July.

The reservoir system would cost local taxpayers \$3.4 million as compared to \$1.48 million for the modification and diversion system.

The Ebner Coulee flood-plain involves about 350 residences, and the modification and diversion plan would cause the relocations of two homes, while the reservoir plan, as the corps now has it planned, would relocate 13 homes.

# Panel Oks Flood Plan For 2 Coulees

B. GEORGE ALTHOFF  
Tribune Correspondent

The State Road-Ebner Coulee flood control project — studies for it have been going on since 1952 — last night moved a step closer to reality.

The County Board's Flood Control Committee voted unanimously to forward the project recommendations to the County Board and the city's Common Council for approval. If both groups approve the plan a city-county liaison committee would be formed to determine from what sources about \$2 million in local funding would come.

The project is divided into two parts — the State Road Coulee portion and the Ebner Coulee portion. Both are located in the Town of Shelby and the City of La Crosse.

Proposed improvements in both areas would include channel widening, with some diversion work proposed for the Ebner Coulee area.

The State Road portion of the project was recommended for approval to the county committee by the State Road-Ebner Coulee Flood Control Committee. A citizen's committee appointed in 1954 to study the flood control problem in the two areas.

The citizens' committee did

not recommend the Ebner Coulee portion because most of the floodplain in that area is on city property, according to Supervisor Robert L. Frederick (35th Dist.), a member of the county committee.

The project includes 553 acres of floodplain — 350 within the State Road area and 203 within the Ebner Coulee area.

Most of the drainage areas of the two portions lies within the Town of Shelby — 3,434 acres of a total 4,015 within the State Road portion, and 5,13 acres of a total 1,255 within the Ebner Coulee portion.

But most of the local construction costs put forth in the study, which was made by the Army Corps of Engineers, is charged to La Crosse — \$625,000 of a total \$1,052,000 for the State Road portion and \$707,000 of a total \$835,000 for the Ebner Coulee portion.

However, the share of the city's costs as opposed to Shelby's costs would have to be worked out by the joint committee that would be formed if both the city and county approve the project.

The projected total annual benefits to the city would be slightly more than \$1.1 million, while Shelby would receive benefits totaling about \$339,000 if the project were completed.

"The question of cost sharing is the problem," said Supervisor Elizabeth Gunderson (35th Dist.), also a committee member. She added that the county would probably have to help Shelby pay for its share of the project.

Admiral Sherman Jones (11th Dist.), chairman of the county committee, said, and I. G. Jones, county engineer, said, "The question of cost sharing is the problem."

**"The question of cost sharing is the problem."**  
**— Supervisor Elizabeth Gunderson, (35th Dist.)**

"Neither the Town of Shelby nor the city can afford the project without help from the county," Mrs. Jones also said that she had wanted the citizens' committee to approve the Ebner Coulee portion of the project.

The study submitted by the Corps is not final, according to Bob Northrup, chief of the advance planning section of the Corps in St. Paul. A final study would be made if the project is given the go-ahead by the nationalities involved, he said.

He said the Corps was authorized by Congress to make the study in 1952, and that impact studies were completed in June of this year.

The Corps studied 13 plans for effectiveness and environmental, social and economic impacts, Northrup said, then chose

what it felt was the best solution to the problem.

Stan Kumpula, the Corps project manager, outlined each portion of the project.

The State Road portion would extend along Paul and Crook from the Illinois River bridge to the city center.

The Ebner Coulee portion would extend from the Illinois River bridge to the city center.

prevail, according to Kumpula. Department of Natural Resources has tentatively zoned the project area into two areas as floodplains. The city is contesting this, she said.

Many portions would require but if it is finalized, then the residents in the areas will be subject to floodplain insurance.

There would also be certain building restrictions that would have to be followed.

One of the problems is that the DNRS and his staff favor actions are limited. These restrictions would hinder the growth of the area, according to Mrs. Jones.

In recommending the State Road Coulee portion for approval, the citizens' committee stressed that three conditions be met.

• That chain-link fence be erected along the channel to give adequate protection for children.

• That there be attractive landscaping along the project Creek where there are residents, and

• That care be exercised so the channel raises, and not lowers, the groundwater table in the area.

In not recommending the Ebner Coulee portion, the committee recommended that the city improve its system of storm sewers as a partial solution to flood control. It recommended that the city utilize the compiled data in determining flood control needs.

Mrs. Jones said she favored both of the projects because the

To Members of the State Road-Ebner Coulee Flood Control  
Committee.

A meeting of the Committee has been scheduled for Thursday, November 7, at 7:30 P.M. in Room 202 of the La Crosse County Court House. Mr. Jack Walsh of the DNR in Madison and Mr. Ray Pelishak, La Crosse County Zoning Commissioner, plan to attend. They will explain such matters as definition of floodplain, identification of areas, zoning restrictions, and others.

Harold A. Classen, Chairman  
October 30, 1974

To: Members of the State Road-Ebner Coulee Flood Control  
Committee.

A meeting of the Committee has been scheduled for Thursday, January 30, at 7:30 P.M. in Room 207 of the La Crosse County Court House. Mr. Stan Kumpula of the St. Paul office Corps of Engineers will present a progress report on the Corps' updating of the 1967 report. Dr. Thomas Claflin will give a summary of environmental impact studies in the watershed, and Dr. Douglas Sweetland and Dr. Lawrence Kellenbach will offer a progress report on their economic analysis for the environmental impact statement.

Harold A. Classen, Chairman  
January 21, 1975

Exhibit 5

Report of State Road and Ebner Coulees Citizens Committee Meeting --  
September 25, 1975, Room 202, La Crosse County Courthouse, La Crosse, Wisconsin,  
54601.

The meeting was brought to order at 7:30 p.m. by Chairman Harold Classen. The following were present:

Harold Classen - Chairman  
Al Mages - Secretary  
James Brindley - Member  
LeRoy Brudos - Member  
James Cropper - Member (Soil Conservation Service)  
Dorothy Dedo - Member  
Barbara Frank - Member  
John Zoerb - Member

Elizabeth Gundersen - La Crosse County Supervisor  
Ronald Bracegirdle - La Crosse City Planner  
Dale Simon - Wisconsin Department of Natural Resources  
Stanley Kumpula - Corps of Engineers  
Robert Northrup - Corps of Engineers  
Pam Miller - Visitor, La Crosse Tribune

Minutes of the September 9, 1975 meeting were approved.

Harold Classen stated that he had received a telephone call from Bob Schroeder, La Crosse City Director of Public Works, concerning the preliminary committee draft for Ebner Coulee. He also stated that he had received just before the meeting a letter written by Bob Schroeder and delivered by Ronald Bracegirdle. The gist of the letter was that any improvement of the city storm sewer system in the vicinity of Farnam Street would not be adequate for the type of runoff that could come out of Ebner Coulee with very heavy rains, and that the original Corps proposal was a superior solution.

A general discussion of the committee draft for State Road Coulee was held. Harold Classen read portions of a letter from Sharon Imes, committee member. The main idea in her letter was that she was reserving approval of the State Road draft until the Ebner Coulee draft was available, because both affected the city of La Crosse. She felt that it would be an inadequate position for the committee not to include control for La Crosse Residences which would be affected by runoff from Ebner Coulee.

A review of the committee draft for Ebner Coulee was held. Harold Classen reread Sharon Imes' letter and read Robert Schroeder's letter. After extensive general discussion James Brindley moved the revised committee draft be accepted (see final report for Ebner Coulee attached). Barbara Frank seconded the motion. The motion passed unanimously.

LeRoy Brudos moved that the State Road Coulee draft be accepted (see attached report for State Road Coulee). John Zoerb seconded the motion. The motion passed with the count of 6 yes, 1 no.

The meeting was adjourned at 10:00 p.m.

Respectfully submitted,

*Al Mages Hac*  
Al Mages, Secretary

AM/hac

Exhibit 6

# DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

REFERENCE OR OFFICE SYMBOL	SUBJECT		
NCSSED-PB	Phase I, GDM, State Road and Ebner Coulees, Wisconsin - Citizen's Committee Meeting		
TO	FROM	DATE	CMT 1
Memo for Record	Planning Branch Engineering Division	31 January 1975 Mr. Kumpula/lg/7472	
<p>1. On 30 January 1975, the fourth meeting of the Citizens Committee for the subject project was held in La Crosse, Wisconsin. Mr. Helmer Johnson, Hydraulics Branch, and I attended the meeting. Others present were reporters for the La Crosse newspaper and a radio station, Thomas Claflin, Doug Sweetland, and Lawrence Daellenbach of the University of Wisconsin-La Crosse, Mrs. Gundersen (La Crosse County Supervisor), members of the citizens committee, and other interested citizens. A list of those attending this meeting will be included in the citizens committee minutes to be furnished to us when completed.</p> <p>2. After introductions, I briefly discussed the format and content for our Phase I, GDM report and the draft sections we have prepared to date. Copies of the draft (Inclosure 1) were given to the committee members and others present. I summarized the information on the current water resources development problems and needs, the plan formulation and evaluation criteria and the various nonstructural and structure measures to be used in considering a number of alternative solutions. Helmer Johnson discussed our hydrologic investigations for the State Road and Ebner Coulee Watersheds and provided handouts (Inclosure 2) relating the various synthetic methods for determining frequency curves.</p> <p>3. Dr. Claflin, who is the principal investigator for the subject project environmental assessment study under contract with the St. Paul District, presented a summary of their investigations to date. He indicated that the authorized project plan would have a minimal impact on the environment of the study area because the project is confined within the boundaries of the existing channelized stream and flanking levee system. The major impact would be during construction of the project and of course, would be temporary. The areas where the major permanent impact would occur would be the downstream portions of the project area, where a number of trees would have to be removed to provide a wider channel. For State Road Coulee, 1,000 to 1,200 mature trees (35 percent are American Elm) would have to be removed in the area of the confluence of State Road Coulee and the Mississippi River. Alternative channel alignments and designs will be examined to substantially minimize any loss of trees in this reach. Dr. Claflin mentioned the poor existing water quality of the stream and indicated that even if it improves, fish populations will be low with or without the project because of the occurrence, at times, of minimal flow. The authorized project includes the diversion of Ebner Coulee north to Miller Coulee, and enlargement of Miller Coulee. In the reach near the confluence of Miller Coulee with a marshy area of the La Crosse River floodplain, a number of trees would also require removal. A possible beneficial effect of this diversion would be the increased flows to the marsh area.</p>			
Exhibit 7			

DA FORM 2496  
1 FEB 62

REPLACES DD FORM 24, EXISTING SUPPLIES OF WHICH WILL BE  
ISSUED AND USED UNTIL 1 FEB 63 UNLESS SOONER EXHAUSTED.

NCSED-PB

31 January 1975

SUBJECT: Phase I, GDM, State Road and Ebner Coulees, Wisconsin - Citizen's  
Committee Meeting

4. Mr. Sweetland and Mr. Daellenbach briefly reviewed their economic studies of the potential damages for the study area. Since these studies require a few more weeks for completion, no specific damage figures or amounts were given.


5. Some general observations about the current opinions of the committee members are:

a. A number of committee members and also other citizens residing in the Ebner Coulee area feel that the Coulee doesn't need much alteration to provide flood protection.

b. Some committee members and Mrs. Gundersen, La Crosse County Supervisor, are concerned about the non-Federal costs being a heavy burden to the County.

Our hydrologic studies indicate that Ebner Coulee does have a potential for causing substantial flood damage to the existing development in the Coulee floodplain. At future committee meetings, additional information on the hydrologic aspects of State Road and Ebner Coulees will be provided. The cost sharing aspects of various alternatives will be fully explained when our studies of the alternative solutions are completed.

c. According to the Agenda previously established for the committee meetings, the next meeting will be in March, 1975 to present the results of our studies of the various alternative solutions investigated.

  
STANLEY R. KUMPULA  
Project Engineer  
Planning Branch  
Engineering Division



September 27, 1975

## STATE ROAD - EBNER COULEE FLOOD CONTROL COMMITTEE

### POSITION PAPER

The State Road - Ebner Coulee Flood Control Committee was organized in the summer of 1974. Members include residents of the Ebner Coulee and Pammel Creek (State Road Coulee) drainage areas and a representative of the Soil Conservation Service. Advisors to the Committee include two La Crosse County supervisors whose districts contain the two drainage areas. The Committee went on a field trip of the drainage areas conducted by representatives of the Corps of Engineers. Visitors at committee meetings included invited persons such as the County Zoning Commissioner, representatives of the Wisconsin Department of Natural Resources, representatives of a consulting firm under contract with the Corps of Engineers, and faculty members of the University of Wisconsin - La Crosse who conducted impact studies of the watershed area for the Corps of Engineers. Meetings were open to the public and were attended by visitors, interested parties, and newspaper, radio and TV representatives.

The Committee recognizes that a potentially dangerous flood problem exists along Pammel Creek, especially in the Wedgewood Terrace area and along both sides of Pammel Creek below Ward Avenue. The floodplain determination for these areas was based on detailed hydrologic investigations by the Corps of Engineers and hydraulic studies by a consulting firm under contract with the Department of Housing and Urban Development. Residential building in these areas has occurred primarily since 1955, and no disastrous floods of major proportions have occurred since that time. The rainiest year was in August, 1959 but no water flow measurements were made at that time. A representative of the Wisconsin Department of Natural Resources stated at a meeting of the Western Chapter of the Wisconsin Society of Professional Engineers (8/14/75) that the State Road Coulee situation was the most serious flood problem in terms of danger to life, in that no adequate warning system could be devised to cope with the sudden rise of Pammel Creek in the event of heavy rainfall and sudden flooding.

The Committee studied the original Corps of Engineers Report on Survey of State Road and Ebner Coulees, Wisconsin for Flood Control, dated 3 November, 1967. The Committee's major efforts, however, were concentrated on the Corps' updating of the original study and on examining the merits of twelve alternative flood damage reduction plans. Certain guiding principles considered in the recommendations of the Committee included the following items:

1. That there be as little relocation of people as possible.
2. That any engineering design be adequate for protection against the 100-year flood possibility.
3. That construction be aesthetically acceptable.
4. That the cost-benefit ratio be at or near the maximum.

### RECOMMENDATIONS -- STATE ROAD COULEE

The Committee recommends that Alternate Plan 10E to the authorized plan in the Survey Report for State Road and Ebner Coulees be the basic approach to flood control along Pammel Creek. This alternate provides for a concrete-lined open channel for Pammel Creek from Hagen Road to the U.S. Highway 14/61 overpass, plus earth channel from that point to the Mississippi River. This plan best meets the

Exhibit 8

Lee's four guiding principles listed above in that it combines the features  
 1) least amount of relocation of people, 2) least disruption of roads, utilities,  
 3) the most desirable aspects of economic development, environmental quality  
 and social well-being, and 4) a high benefit-cost ratio.

In any development of this proposal by the Corps of Engineers, the Committee  
 has its concern that the following conditions be met or incorporated in the

that chain-link or similar fencing be erected so as to give adequate  
 protection to children.

that there be attractive landscaping where there are residences along  
 Pammel Creek.

that care be exercised that the concrete-lined channel does not result in  
 a raising of the ground water table, but instead lowers it.

The Committee further recommends that the appropriate local governmental  
 or agencies take the necessary steps to meet with the Corps of Engineers for  
 action on this proposal.

#### RECOMMENDATIONS -- EBNER COULEE FLOODPLAIN

In reviewing the options for flood control in the Ebner Coulee Floodplain,  
 the Committee considered three possibilities: a storage reservoir with an  
 enclosed conduit, a diversion with an enclosed conduit, and no action at all.

It was felt by the Committee that each of the latter two proposals had  
 major disadvantages which tended to outweigh any benefits. The cost would be prohibitive:  
 \$2.3 million for the storage reservoir and enclosed conduit -- \$2.3 million of that  
 cost would be from local funds; and \$7.5 million for the diversion and enclosed conduit -- \$1 million  
 from local funds. Furthermore, neither plan would provide more than 70%  
 protection of the flood plain. Both proposals would necessitate relocating two  
 businesses, and the reservoir/enclosed conduit plan would in addition require  
 relocating two businesses (La Crosse Floral and Baier Landscape Nursery).

The Committee therefore recommends:

that no action be taken in the Ebner Coulee Floodplain by the Corps of  
 Engineers. If an alternative is desired, however, Plan 12, Diversion  
 with Enclosed Conduit, should be considered.

that the City of La Crosse, as a partial solution, undertake the  
 improvement of storm sewers draining the area, as such improvements  
 would greatly speed up dispersal of excessive runoff.

that insofar as possible, all of the data compiled in this study be  
 utilized by the City of La Crosse in determining its flood protection  
 needs.

W. J. La Crosse-Chairman

W. J. La Crosse-Secretary

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

W. J. La Crosse

Adopted September 25, 1975

14 August 1974

Mr. Jack Hemphill  
Regional Director  
U.S. Fish and Wildlife Service  
Department of the Interior  
Federal Building  
Fort Snelling  
Twin Cities, Minnesota 55111

Dear Mr. Hemphill:

This is to advise you of our current studies concerning a flood control project for State Road and Ebner Coulees, Wisconsin, which drain watersheds located on the east side of the city of La Crosse. The project was authorized by the Flood Control Act of 1968, as described in House Document No. 360, 90th Congress, 2d Session.

Funds appropriated by Congress in fiscal year 1974 have made possible the initiation of advance planning which will reaffirm or reformulate the authorized project. This planning will take into account any changes in public desires and needs since the original survey and insure that the project plan is the best solution to meet current requirements for economic feasibility and environmental quality as national objectives, with consideration for social well-being and regional development.

The authorized plan provides for channel modification of portions of State Road and Ebner Coulees and also diversion of Ebner Coulee to an enlarged Miller Coulee which carries flows to a marshy floodplain of the La Crosse River. Modification of State Road Coulee would consist of deepening and enlarging the existing channel from the vicinity of the Hagen Street bridge to the mouth with most portions being concrete-lined. Modification of Ebner Coulee would include deepening and enlarging a portion of the downstream channel by means of a concrete-lined channel and then diversion of flood flows through underground twin concrete conduits to an enlarged Miller Coulee channel with both earth and concrete sections. The inclosed plans (three plates) show the authorized project features for each coulee with a tabulated summary of the principal features shown on the inclosed table.

Exhibit 9

NCSEB-FB

14 August 1974

Mr. Jack Hemphill

Comments by your agency on our previous study were included in our 1967 survey report. A copy of your letter furnishing comments is inclosed. We would appreciate receiving your current views by 31 August 1974 regarding this project. As our studies progress to the point where we have updated our hydrologic, economic, and environmental data for the study area, we will again request comments or assistance on those aspects related to your areas of responsibility.

Recently, a citizens committee was formed by La Crosse County and is composed of a cross section of individuals representing a variety of interests. The committee is a fact finding and advisory organization. Committee meetings are held about once a month to review alternative solutions to the flood problems in the coulees. Based on considerations of the favorable and unfavorable effects of various alternative solutions, the committee will attempt to reach a consensus regarding the scope and nature of the improvement plan considered to be in the best public interest. The committee may also ask for the views of your agency on various alternative solutions being considered to solve the water management problems in the coulees.

If you need further information or have any questions, please call or write us. The study is being handled through our Planning Branch with Mr. Stan Kumpula (telephone No. 612-725-7472) directing the study.

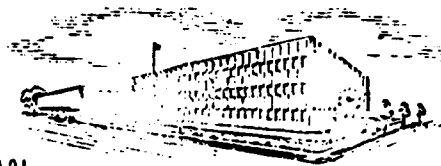
Sincerely yours,

NORMAN C. HINTZ  
Major, Corps of Engineers  
Acting District Engineer

Chairman County Board

**LA CROSSE COUNTY, WISCONSIN**

COURTHOUSE, LA CROSSE, WISCONSIN 54601



Telephone 784-3783

July 28, 1976

Forrest T. Gay, III  
Colonel, Corps of Engineers  
District Engineer  
Department of the Army  
St. Paul District, Corps of Engineers  
1135 U. S. Post Office & Custom House  
St. Paul, Minnesota 55101

Dear Colonel Gay:

Re: NCSED-PB

I am writing you in regards to your letter of July 26, 1976. It is my consensus after conferring with Mayor Patrick Zielke that there will be no action taken in the near future on either the State Road or Ebner Coulee projects.

I am enclosing a copy of the City-County Liaison Committee meeting and the Town of Shelby letter to Mr. Ipsen.

Sincerely,

William L. Bush  
County Board Chairman

WLB:bcw;sf

Exhibit 11.

26 July 1976

Mr. William Bush  
Chairman, La Crosse County  
Board of Supervisors  
County Courthouse  
La Crosse, Wisconsin 54601

Dear Mr. Bush:

I am writing to you with regard to the telephone conversation on 9 July 1976 between you and Mr. Roger Fast, Chief, Engineering Division, concerning the State Road and Ebner Coulees, Wisconsin, flood control project.

Our studies for the project were essentially completed in December 1975, and the preliminary working papers for our draft report were furnished to the La Crosse Area Flood Control Committee on 16 January 1976. Since that time we have maintained contact by telephone or letter with either Mr. Bruhnke, former La Crosse County Board Chairman; Mr. Ipsen, La Crosse Area Flood Control Committee; or Mr. Ron Bracegirdle, Director of Planning, city of La Crosse.

I would appreciate being advised of the current status of local support for the project. The public works budget for fiscal year 1977, beginning in October 1976, includes \$300,000 for continuation of project planning for State Road and Ebner Coulees. Without an expression of continued interest by La Crosse County, I will recommend the project be reclassified from "active" to "inactive" and that these funds be transferred to another project.

Please respond to this letter indicating the official position of the county regarding local support for either one or both features of the State Road and Ebner Coulees flood control plan. Either the State Road or the Ebner Coulee portion of the overall plan could proceed separately, if desired locally, since our studies indicate that each coulee has different flood damage areas and independent economic feasibility.

Should you desire any additional information or wish to discuss this matter further, please let me know.

Sincerely,

FORREST T. GAY, III  
Colonel, Corps of Engineers  
District Engineer

Exhibit 10

*Town of Shelby*

2801 WARD AVE.  
LA CROSSE, WISCONSIN 54601  
KRM:JCL

Phone 788-103

January 2, 1976

Wilbert Ipsen, Chairman  
Flood Control Committee  
County Board  
County Court House  
LaCrosse, Wis. 54601

Dear Mr. Ipsen,

The Shelby Town Board has been asked to take a position on the State Road, Ebners Coulee Flood Control Project. After reviewing the information given us, the Board has voted against both proposals. We feel there has not been adequate evidence presented, to indicate the damage that has occurred in the past years or possible future damage, to warrant an expenditure of this size. The cost to the town we feel is excessive and well beyond it's spending capabilities. The Board also objects to the huge expenditure of public monies which this project suggests.

If you have any further questions please feel free to contact any of the board members.

Very truly yours,

SHELBY TOWN BOARD

*Jeffrey L. Brudos*  
Jeffrey L. Brudos,  
Town Clerk

JLB:nc

cc: Elizabeth Gundersen, County Supervisor  
Robert Frederick, County Supervisor  
Harold Clausen, Citizens Flood Control Committee Chairman

City-County Liaison

City-County Liaison  
17th March

76

At the meeting of the City-County Liaison Committee, the Shelby Town Board reported they were not interested in funding their portion of the project. Therefore, it was the consensus of the Liaison Committee that we had nothing further to act upon.

PZ

\*\*\*\*\*



RESOLUTION

WHEREAS, the U.S. Army Corps of Engineers, St. Paul District has prepared a comprehensive study to determine flood potentials in State Road Coulee, LaCrosse County, Wisconsin and said study does provide possible methods for flood control in this coulee; and

WHEREAS, flood potential within this watershed is a definite hazard with considerable flood possibilities; and

WHEREAS, when and if flood did occur in these areas there would be a definite health and safety hazard to residents of both the City of LaCrosse and the Town of Shelby;

NOW, THEREFORE, BE IT RESOLVED: that the Town of Shelby Board in session this 10th. day of July 1978 does hereby support the U.S. Army Corps of Engineers in the planning of flood control measures and the implementation of the recommended project. The Town Board will cooperate with all municipalities involved to the best of its ability.

Kent Kuch

Town Chairman

William B. B. B.

Town Supervisor

George Brodgen

Town Supervisor

ATTEST:

Grothby Dado

Town Clerk



cc Mayor  
P. W. Dwyer  
Do. Dwyer f.

## REPORT OF COMMITTEE

To the Honorable Mayor and Common Council of the City of La Crosse.

Gentlemen:

Your Highways, Properties & Utilities Committee

..... having under consideration the  
annexed Resolution endorsing support of Ebner and State Road Coulees Flood  
Control Project, recommend same be adopted.

### REPORT AND RESOLUTION ADOPTED

JUL 13 1978

BY COUNCIL

Respectfully submitted

Ald. Joseph J. Addis  
Paul W. Schneider  
Randall G. Larson  
Curtis J. Storck  
Frank M. Kaufmann  
John D. McConaughy  
David J. Harter  
Committee on Highways, Properties  
& Utilities

JUL 16 1978

BOS.  
✓ Planning  
C. K. Smith  
City Eng.  
Passed .....  
Approved .....

## RESOLUTION

Resolution endorsing support of Ebner  
and State Road Coulees Flood Control  
Project.

WHEREAS, the United States Army Corps of Engineers, St. Paul District, has undertaken a study to determine the flood potential in State Road and Ebner Coulees, Wisconsin, and to recommend the most appropriate method for flood control in these coulees; and

WHEREAS, the results of such study have been published in a report entitled, Flood Control, State Road and Ebner Coulees, Wisconsin, General Design Memorandum, Phase 1, Plan Formulation and Hydrology, dated November, 1976; and

WHEREAS, it has been established that there presently are over 1,100 residences located within the flood plains of both coulees and, therefore, are subject to damage through flooding; and

WHEREAS, floods which could occur in the State Road and Ebner Coulee flood plains endanger the health and safety of the residents of such flood plains; and

WHEREAS, the United States Army Corps of Engineers have indicated that at least one flood has been experienced in the State Road Coulee flood plain since 1955 which has caused damage to property and that on several occasions property damage has occurred since that time from Ebner Coulee overflows; and

WHEREAS, State Statutes and Administrative Regulations require the City to enact flood control regulations to regulate the development in flood plain areas; and

WHEREAS, the Federal Insurance Administration has requested the City to adopt flood control legislation to control development in the Ebner Coulee and State Road flood plains; and

JUN 11 1976  
HPH  
Shelby Town  
Clerk  
County Rd  
1654  
J-P

WHEREAS, the enactment of such regulations for these coulees would prevent the development of a substantial amount of vacant land within the City thereby limiting the expansion of its tax base; and

WHEREAS, such regulations would impose an economic hardship upon citizens of La Crosse presently residing or owning property in the flood plains of Ebner and State Road Coulees; and

WHEREAS, the implementation of the United States Army Corps of Engineers' flood plain projects for Ebner and State Road Coulees would eliminate the need for flood control regulations in such areas;

NOW, THEREFORE, BE IT RESOLVED: that the City of La Crosse supports the United States Army Corps of Engineers in their efforts to develop flood control projects to eliminate the threat of flood in Ebner and State Road Coulees; and

BE IT FURTHER RESOLVED: that the City of La Crosse supports any action which may be required by the United States Army Corps of Engineers which may be necessary for the implementation of such flood control projects; and

BE IT FURTHER RESOLVED: that the City of La Crosse is willing to pay its fair share of the local cost which would be required for the implementation of such projects; and

BE IT FURTHER RESOLVED: that the City of La Crosse is willing to work with the Town of Shelby and La Crosse County to develop a mutually satisfactory formula which would allocate the local cost of such projects to the three units of local government on a reasonable basis.

COUNTY OF LA

I, Russell L. Fiedler, County Clerk of La Crosse County, do hereby certify that the attached resolution is a true and correct copy of the original resolution required by law to be in my custody and which was adopted by the County Board of Supervisors of La Crosse County at a meeting held on the 17 day of Sept, 1978.

*Russell L. Fiedler*  
Russell L. Fiedler  
La Crosse County Clerk

TO: The Honorable County Board Chairman and Supervisors  
La Crosse County, Wisconsin

MEMBERS OF THE BOARD:

WHEREAS, the Town of Shelby and the City of La Crosse have passed Resolutions supporting a study of the Pammel Creek area in view of the potential flooding, by the U.S. Corps of Engineers, and;

WHEREAS, Pammel Creek involves the Town of Shelby, the City of La Crosse, and the County of La Crosse, and;

WHEREAS, the Soil and Water Conservation District have gone on record as supporting a continued study by the U.S. Corps of Engineers relative to the flood potential of the Pammel Creek Area.

NOW, THEREFORE, BE IT RESOLVED:

That the La Crosse County Board does hereby approve a continuing study of the Pammel Creek area by the U.S. Corps of Engineers, and the Board wishes to inform said Corps of Engineers that La Crosse County will support and cooperate with all areas of government in correcting this situation and will serve as the sponsoring unit of government to coordinate the various ramifications of this project.

Dated this 17 day of August, 1978, at  
La Crosse, Wisconsin.

SOIL & WATER CONSERVATION DISTRICT

*Amended to include  
the Ebners Coulee  
Area also.*

*Don H. H. H.*  
*Don H. H. H.*  
*Don H. H. H.*  
*Don H. H. H.*



DEPARTMENT OF THE ARMY  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
1135 U S POST OFFICE & CUSTOM HOUSE  
ST. PAUL, MINNESOTA 55101

REPLY TO  
ATTENTION OF:  
NCS-ED-ER

19 February 1980

The St. Paul District, Corps of Engineers, proposes to implement a flood damage reduction plan for the State Road Coulee floodplain in La Crosse, Wisconsin. This plan would increase the capacity of the State Road Coulee channel (also known as Pammel Creek) by deepening and enlarging the downstream portion. The proposed action includes construction of a drop structure, a stilling basin, ~~five~~<sup>four</sup> new street bridges, modifications to a railroad bridge, sewer and water lines, and a pilot channel for State Road Coulee.

Because the proposed action would have a significant impact upon the quality of the human environment, we will prepare an environmental impact statement (EIS) on the project.

Council on Environmental Quality (CEQ) regulations (40 CFR 1501.7) require that a scoping process be used "for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." This letter initiates the scoping process and invites your participation in the development of the EIS.

Among the purposes of the scoping process is the identification of the action or proposal to be addressed in the EIS, as well as reasonable alternatives to the proposed action. Another important function of the scoping process is to identify the major or significant issues associated with the proposal. These significant issues would then be analyzed in depth within the EIS while issues identified as not significant would not be analyzed in such depth. Finally, the primary purpose of the scoping process is to make the EIS a more concise, meaningful document that concentrates on the significant issues.

Exhibit 13

PROPOSED SCOPE FOR THE ENVIRONMENTAL  
IMPACT STATEMENT ON FLOOD CONTROL,  
STATE ROAD COULEE, LA CROSSE, WISCONSIN

The purpose of this scope is to identify the proposed action, reasonable alternatives, and impacts to be addressed in the environmental impact statement (EIS) on the State Road Coulee Project. This scope also will identify the significant issues and impacts to be analyzed in depth within the EIS plus the non-significant issues which will not be analyzed in such depth.

A. Proposed Action

The proposed flood damage reduction plan would increase the capacity of State Road Coulee in La Crosse, Wisconsin, by deepening and enlarging the downstream portion of the channel. The EIS will describe the project design, evaluate alternatives, analyze important issues related to the project, assess significant impacts, appraise the relationship of the plan to environmental requirements, and identify any necessary mitigation measures.

B. Alternatives

The alternatives to be considered include the no action alternative, reasonable alternatives to the proposed action, and the proposed action itself. Reasonable alternatives would accomplish partial or total flood damage reduction along the State Road Coulee channel. The following list of alternatives will be considered in the EIS:

1. Proposed action, i.e., deepening and enlarging the lower portion of the State Road Coulee channel.

. Much of the land use in the State Road Coulee watershed has been consistent with proper watershed management. Further development in the watershed will likely contribute to even greater runoff, while new development constructed in the floodplain along the lower reaches of Pammel Creek become increasingly subject to flooding.

. Increased channel capacity could encourage and induce development in floodplain areas and in the upper portions of the watershed.

. The concrete-lined, fenced-in channel could be a safety hazard to neighborhood children, and it could have a negative aesthetic and intrusive impact on residences in the project area. The channel would be designed to minimize these potential negative impacts as much as practicable.

. The lower terminus of the channel would cause a loss of about 2 acres of relatively valuable riparian and floodplain habitat.

. Temporary increases in sedimentation during construction, increased hydraulic efficiency of the modified channel, and potential drainage of adjacent floodplain habitat along the earth pilot channel at the lower terminus could impact the Mississippi River aquatic ecosystem below the terminus and the adjacent river floodplain areas identified as northern pike spawning habitat and as general feeding and resting habitat for other wildlife species.

. The channel alignment below Highways 14 and 61 may affect a known natural resources site listed in the National Register of Historic Places. The nature and extent of this site must be determined and the channel alignment should be routed so that it has a minimal impact on the site.



E. Lead and Cooperating Agencies

The St. Paul District, Corps of Engineers, will prepare the EIS. The U.S. Fish and Wildlife Service is the only cooperating agency in the sense defined in 40 CFR 1501.6. However, we invite the participation of concerned Federal, State, and local agencies; any affected Indian tribes; and other interested persons. We will consult and coordinate with those agencies that have a direct interest in this project and/or special expertise in areas of project impact.

# Town of Shelby

2801 WARD AVE.  
LA CROSSE, WISCONSIN 54601

Phone 788-1032

March 17, 1980

William W. Badger  
Colonel, Corps of Engineers  
Dept. of the Army  
1135 U.S. Post Office & Custom House  
St. Paul, Minn. 55101

Attn: NCSED-ER

Dear Colonel Badger:

To follow up on my telephone conversation with Carl Stephan on March 4, 1980 I want to confirm the following facts determined by the Shelby Town Board, County of LaCrosse:

1- We do not condone a no action program but concur to reasonable alternatives to the proposed action accomplishing almost total damage reduction along State Road Coulee Channel.

2- In reference to your proposed scope for the E.I.S. on flood control: B. Alternatives the town board stresses compliance with the following list of alternatives to be considered:  
1, 3, 5, 6, 7, 8, 9, 11, 12 & 14.

3- Regarding item 9 the Town Board strongly recommends that an up stream engineering survey be completed (above the Hagen Road bridge) to determine stream bed capacity, needed improvements and especially flood fringe and floodway delineations.

The Shelby Town Board is interested in proper flood control programs in State Road Coulee and sincerely hope that the Corps of Engineers continue with needed development plans.

Keith Kuehn  
Keith Kuehn, Chairman

Kathleen Kistner  
Kathleen Kistner

George Snodgrass  
George Snodgrass

Exhibit 14



## United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

GREEN BAY FIELD OFFICE (ES)

Univ. of Wisconsin-Green Bay  
Green Bay, Wisconsin 54302

November 5, 1980

Colonel William W. Badger  
District Engineer  
U.S. Army Corps of Engineers  
St. Paul  
1135 U.S. Post Office & Custom House  
St. Paul, Minnesota 55101

Dear Colonel Badger:

This provides the U.S. Fish and Wildlife Service's Stage 2 report to accompany your Phase I General Design Memorandum Plan Formulation Report regarding the State Road Coulee Project at La Crosse, Wisconsin. As part of the scope of work for Fiscal Years 80 and 81, we are providing an analysis of the impacts to fish and wildlife resources of several structural alternatives being considered to control flooding on State Road Coulee.

These comments are submitted in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended 16 U.S.C. 661 et seq.). They are also consistent with the National Environmental Policy Act of 1969 and Presidential Executive Orders 11988 and 11990 on Construction Activities in Floodplains and Wetlands.

### STUDY AREA

The project area is in south La Crosse and adjacent to the Mississippi River (Figure 1). The upper reach of the State Road Coulee is channelized and flows through a predominately urbanized area. The lower portion, also called Pammel Creek, is generally considered the area downstream from the State Highway (STH) 14/61 underpass. Here the creek is less altered and flows to the Mississippi River through a relatively undeveloped floodplain forest consisting of wetland Types 1, 2, 3, and 4 (USDI, Fish and Wildlife Service, Wetlands of the United States, Circular 39). According to our new Classification of Wetlands and Deepwater Habitats of the United States, the wetlands are of the Riverine and Palustrine Systems and include the following classes: Unconsolidated Bottom, Aquatic Bed, Emergent Wetland, and Forested Wetland.

## ISSUES AND PLANNING OBJECTIVES

As we stated at the April 11, 1980 scoping meeting, our principal concerns with the project are potential adverse effects of channel modification to the stream, wetlands, and floodplain forest of lower Pammel Creek from the STH 14/61 underpass to the creek's confluence with the Mississippi River. This stretch of Pammel Creek flows through a floodplain forest community which provides valuable habitat for a diversity of wildlife including white-tailed deer, muskrats, mink, great blue herons, black-crowned night herons, egrets, rails, wood ducks, songbirds, raptors, cottontails, fox, skunks, raccoons, fox and gray squirrels, reptiles, and amphibians. Also, the confluence of the creek and the Mississippi River provide excellent habitat for numerous species of waterfowl and marsh birds. An extensive reed canarygrass marsh in this area is good northern pike spawning habitat. We are opposed to completely channelizing Pammel Creek from the underpass to the Mississippi River because of its destructive effects to fish and wildlife habitat and possible adverse impacts to our refuge. In our opinion, this would contravene Executive Orders 11990 and 11988 on Protection of Wetlands and Floodplain Management. Channelization in the extreme lower terminus of the creek would also aggravate an already illegal trespass problem on our refuge by creating easy access on the new dike or through the road that would be built to maintain the channel. In view of the above, we believe the primary environmental planning objectives are to develop a flood control plan which minimizes to the greatest extent possible damage to lower Pammel Creek and its associated floodplain forest community and also, to avoid any physical intrusion into our refuge.

## PLANS OF DEVELOPMENT AND IMPACTS

In the upstream area of the project, the preferred channel modifications for the 2.2 mile stretch of the State Road Coulee between Hagen Road and the STH 14/61 overpass consist chiefly of lining the existing channel with 12 inches of concrete to protect the channel from high velocities and scour and also, excavating a stilling basin downstream from Ward Avenue to reduce high velocities caused by the steep slopes in that area. This area has minimal fish and wildlife values because former channelization has eliminated meanders, pools, riffles, and other natural characteristics which are necessary for aquatic flora and fauna diversity. Also, the steep channel banks do not support a diverse plant community. Armoring the channel with concrete would eliminate instream scour and stream side erosion, but it would also remove the remaining riparian vegetation and instream aquatic habitat used mainly by songbirds, small mammals, reptiles, amphibians, and possibly some forage fish. No unique wildlife habitats are known to occur in the upstream area of the coulee.

We understand that five channel modification alternatives are currently being considered for Pammel Creek downstream from the STH 14/61 underpass (Figures 2 & 3).

Earth pilot channel - The existing channel would be widened and deepened several hundred feet downstream to a point near the creek's confluence with the Mississippi River. At that point flood flows would disperse overland into the marsh area of the Mississippi River. A levee would be built along the south side of the trees to protect cropland in that area.

Northwest channel - A new earth channel with levees on each side would be routed through a grass playground northwest of Pammel Creek to avoid some of the creek's wooded riparian vegetation. However, clearing floodplain forest farther downstream would be unavoidable. The channel would extend into the Mississippi River floodplain and end near the river.

Southeast channel - This channel is essentially the same as the northwest alignment except that it is directed southeast of Pammel Creek to avoid floodplain forest in the left bank area of the creek.

Stilling basin - A 5 acre permanent catch basin would be excavated in the playground area, just downstream from the underpass. Flood flows would be slowly released to Pammel Creek through a riprapped outlet control structure and allowed to disperse overland to the floodplain forest.

Riprapped channel - Instead of a stilling basin, a riprapped channel would be routed through the playground. A notched riprapped outlet structure would discharge controlled flows to Pammel Creek and the floodplain.

EARTH CHANNEL IMPACTS - The pilot, northwest, and southeast earth channel alternatives have several adverse environmental effects in common, the most obvious being the conversion by channelization, of a natural stream to an artificial water conveyance facility. The biological effects of channelization are well documented in the literature. Widening or deepening Pammel Creek or completely diverting it to a new artificial channel would cause irreparable damage to the creek. The pilot channel would eliminate instream riffles, pools, bank cover, and wetlands which are habitats that shorebirds, waterfowl, furbearers, fish, invertebrates, and other terrestrial and aquatic life depend on. Instead, a more monotypic biological community would occur as a result of reduced species diversity; a typical result of channelization. A severe impact of the northwest and southeast channel alignments is that lower Pammel Creek would be completely diverted from its natural channel. Thus, lower Pammel Creek and its associated natural biota would cease to exist. Wildlife populations would suffer a direct loss of habitat by clearing river birch, elm, maple, ash, boxelder, cottonwood, willow, and other floodplain trees and understory vegetation. As proposed, the southeast channel would require the least amount of clearing of the three alignments.

The earth channels would cause a large amount of sediment to collect at the confluence of Pammel Creek and the Mississippi River, not only in the short term during construction but also over the long term as sediment washes into the coulee from erosion in the watershed. Abundant stands of aquatic vegetation dominated by reed canarygrass (Phalaris arundinacea) but including arrowheads (Sagittaria spp.), and yellow water lilies (Nuphar spp.) occur in the confluence area of the river and creek, and

provide excellent northern pike spawning habitat. A large sediment accumulation here would cause irreversible damage to the marsh and northern pike spawning grounds.

Significant secondary impacts could also result from the earth channels. A major concern is that if the project reduces the size of the 100-year floodplain, the present floodplain of the State Road Coulee could become available for development. As is stated in Mr. Robert Post's July 6, 1979 letter, the floodplain would be reduced from 371 acres to 29 acres. Further development would likely result in more clearing of floodplain forest thus eliminating yet more valuable bottomland wildlife habitat. In our opinion, to select a plan that could allow this would be in direct conflict with Executive Order 11988 on Floodplain Management.

Finally, another major concern with the earth channel proposals is that they would aggravate an already illegal trespass problem on our refuge. Some type of access road would be needed along the channel for maintenance purposes (i.e., dredging or debris removal, etc.) and the road would allow easy entry.

STILLING BASIN AND RIPRAPPED CHANNEL IMPACTS - According to your conceptual plans, the stilling basin or riprapped channel alternatives would eliminate the need for the earth channel designs. Accordingly, the lower terminus of Pammel Creek, where the best fish and wildlife resources exist, would not be severely damaged. As proposed, floodwater would be released from an outlet control structure and then be allowed to disperse into the floodplain forest and wetlands downstream. This would make that area undevelopable and thereby preserve valuable bottomland fish and wildlife habitat. Further, we anticipate that impacts to our refuge would be minimal.

If the stilling basin were constructed according to the design criteria used for wildlife ponds it could help wildlife by providing more interspersed habitat types. The impoundment would also serve as a catch basin for sediment and thereby reduce the amount that would accumulate downstream in the creek and delta area. This would be especially beneficial to northern pike spawning habitat in the mouth area. The pond would probably have to be dredged periodically to maintain its usefulness. There are however, potential problems with an impoundment. For example, the pool would "catch" nutrients from the watershed and nuisance algae blooms could occur. If the water became frequently quiescent in the pool, heavy duckweed growth could result. Wetland vegetation may become established in the basin but if it was later removed by dredging, little wildlife enhancement would be accomplished. Other questionable features of the stilling basin are whether or not it would trap fish when back-up water from the Mississippi River receded and whether or not enough water would be available during low flows for adequate discharge to sustain the downstream aquatic community. More detailed studies would be needed before we could predict site specific impacts with certainty.

The riprapped channel alternative would eliminate the need for a stilling basin or the earth channel options. Pammel Creek would be permanently diverted through the riprapped channel for a few hundred feet then routed back to its natural channel. A consequence of this is the instream biological community in the diverted portion of the creek would be eliminated. On the other hand, a partially offsetting impact of riprap at the water's edge is the rock provides substrate for colonization of aquatic invertebrates. Also, if the rock is large enough it may create shelter crevices for minnows and crayfish. Much of the existing floodplain vegetation could be saved if the road for channel maintenance were built on the right bank in the playground area rather than the left bank area, where wildlife habitat is better.

#### DREDGE DISPOSAL

A substantial amount of sediment would be generated by dredging and other excavation required to construct the project. We understand that the disposal sites will be selected and evaluated in detail during Stage 3 project studies. This is acceptable to the Service, but please note that our policy for disposal is in an upland site out of the 100-year floodplain and exclusive of wetlands or other valuable wildlife habitat.

#### ENDANGERED AND THREATENED SPECIES

Our letter dated June 19, 1980 recommended that you conduct a mussel survey and a bald eagle winter survey to determine whether or not Higgin's eye pearly mussels (Endangered Species) occur in the project area and if bald eagles (Threatened Species) use the area for wintering. Please contact the Area Manager regarding the results of the biological assessment.

#### COORDINATION & SUMMARY

On September 23, your staff held an interagency meeting with the Wisconsin Department of Natural Resources (WDNR) and our agency primarily to discuss the riprapped channel and stilling basin alternatives. It was generally agreed that the riprapped channel alternative was the best presented thus far to minimize adverse impacts to lower Pammel Creek and its associated floodplain forest habitat. Assuming that the proposed riprapped channel did not extend any farther downstream than shown in your conceptual drawing on Plate 10, the riprapped channel (Alternative 2) would be our first preference. The stilling basin option may have potential, but as previously mentioned there are some possible problems which need further study. Lastly, the three earth channel alternatives are unacceptable.

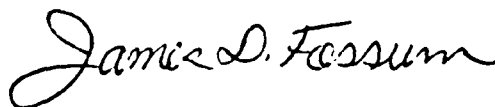
#### CONCLUSIONS AND RECOMMENDATIONS

1. The pilot, northwest, and southeast earth channel proposals downstream from the STH 14/61 overpass are unacceptable and should not be developed because they would cause significant damage to the stream, wetlands, and floodplain forest of lower Pammel Creek and our refuge.

2. Any proposed channel alteration on refuge lands would be subject to our approval of right-of-way and determination of compatibility with refuge objectives.
3. Of the structural alternatives presented thus far in project planning, the riprapped channel (Alternative 2) appears to best minimize adverse impacts to fish and wildlife resources.
4. The stilling basin (Alternative 1) has potential for wildlife enhancement; however, more detailed study would be necessary pertaining to the environmental concerns previously discussed before impacts could be accurately predicted.
5. Any access road built for channel maintenance should be on the right bank of Pammel Creek in the playground to avoid clearing floodplain forest in the left bank area.
6. Disposal sites in wetlands and floodplains should be eliminated from further consideration.
7. To comply with Section 7 of the Endangered Species Act of 1973, as amended, you should conduct a Higgin's eye pearly mussel survey and a bald eagle winter survey of the project area.

We hope this report and our other previous correspondence will help you develop the environmental impact statement and we look forward to further input in project planning to help you develop an environmentally acceptable plan.

Sincerely yours,



James D. Fossum  
Acting Field Supervisor

cc: John Lindell, Upper Miss. Refuge, La Crosse, WI  
Jerry Shotzko, Upper Miss. Refuge Headquarters, Winona, MN  
DuWayne Gebken, WDNR, Madison, WI  
Dale Simon, WDNR, La Crosse, WI  
Rick Pitorak, US EPA, Chicago, IL





Figure 2. Earth channel alternatives for the State Road Coulee lower terminus

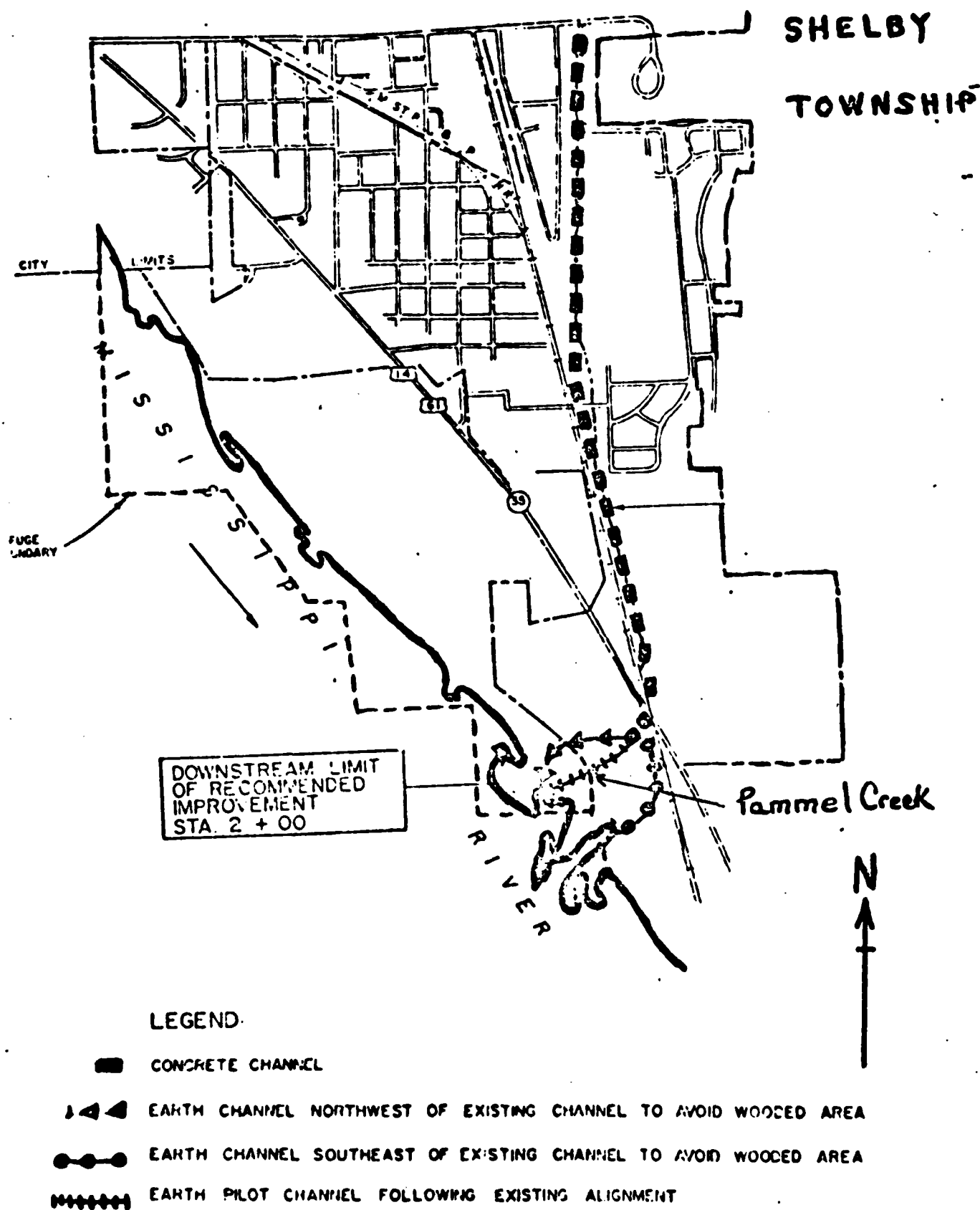
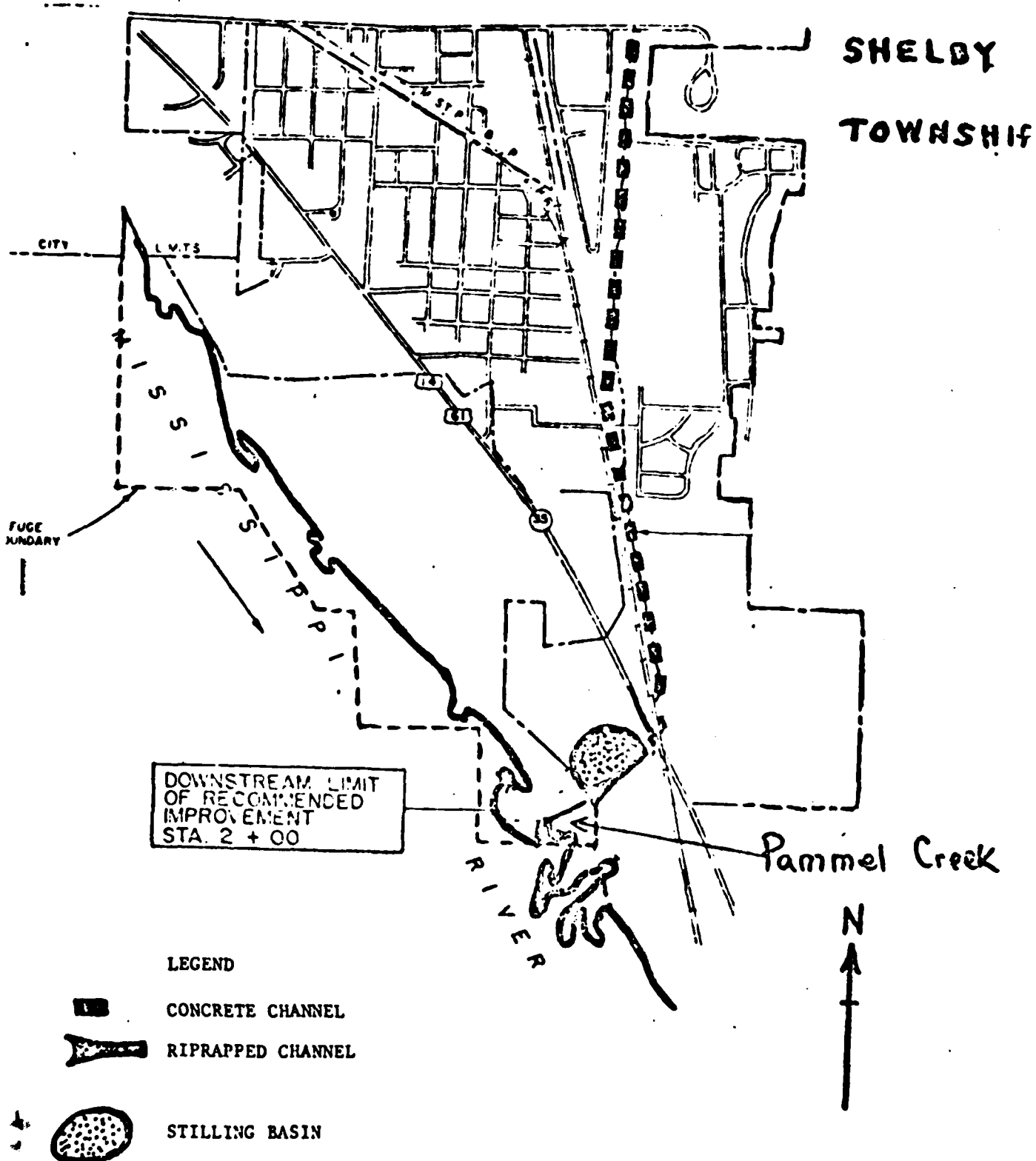


Figure 3. Stilling basin and riprapped channel alternatives for the State Road Coulee lower terminus





OFFICE OF  
**CITY ENGINEER**  
CITY HALL  
LA CROSSE, WISCONSIN 54601

November 14, 1980

Colonel William W. Badger, District Engineer  
Department of the Army  
Corp of Engineers, St. Paul District  
1135 U.S. Post Office & Custom House  
St. Paul, MN 55101

Attention: Mr. Carl Stephan

Dear Mr. Stephan:

The Corp of Engineers has indicated that the Ebner Coulee Project, La Crosse, Wisconsin, appears to not meet the cost benefit ratio necessary for federal cost sharing. The Common Council of the City of La Crosse has directed this department to investigate alternatives that may be implemented to relieve flooding that occurs due to the drainage from the Ebner Coulee area.

An alternative that has been proposed for installing a conduit from Farnam Street southerly to Broadview Place where it would then discharge into the State Road Coulee drainage ditch. The proposed storm sewer would be designed to handle approximately 1,000 cubic feet per second. I would like to request that the Corp of Engineers investigate to what extent that the proposed State Road Coulee Flood Control Project would have to be modified to handle this additional flow.

I would like to also obtain from the Corp of Engineers typical structure or method by which the flows would be dispersed as they enter State Road Coulee Project.

If the Corp of Engineers has any other information that would help in evaluating the proposal, it would be greatly appreciated.

Sincerely,

Bernard A. Mullenbach, P.E.  
City Engineer

BAM:rl

STATE ROAD COULEE - RECREATION RESOURCES

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PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

STATE ROAD COULEE - RECREATION RESOURCES

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## APPENDIX 2

### STATE ROAD COULEE - RECREATION RESOURCES

#### INTRODUCTION

The purpose of this appendix is to evaluate the proposed flood control project in terms of (a) its impacts on existing recreational facilities and uses and (b) its potential to provide or accommodate recreational opportunities.

The proposed State Road Coulee flood control project calls for approximately 2.5 miles of channel modifications. The existing channel would be widened, deepened, and lined with concrete. (The channel has been straightened and leveed in the past to try to control flooding.)

The major recreational use associated with channel modifications for flood control is trails. The linear nature of these projects provides corridors for trail development while the limited lands involved generally preclude more extensive development. Therefore, land associated with the proposed project could be used to help meet some of the trail needs of La Crosse.

The demand for trail-based recreational opportunities has increased during recent years. One component of this demand is the increasing use of the bicycle for transportation and recreation. The Park and Recreation Plan<sup>(1)</sup> and the Bikeways<sup>(2)</sup> plans for La Crosse indicate a need for additional trail opportunities. The plans recommend that trails be incorporated into proposed flood control projects. The 1977 Wisconsin State Comprehensive Outdoor Recreation Plan (SCORP) recommends emphasis be given to developing a bikeway from La Crosse to Goose Island Park, south of the city.

---

(1) "Park and Recreation Plan for the La Crosse Area." 1972. City of La Crosse Planning Department.

(2) "Bikeways for the La Crosse, Wisconsin, Area." 1975. City of La Crosse Planning Department.

The land surrounding the project is developed, predominantly residential. No existing recreational developments would be affected by the project. The channel area itself is relatively open and does provide for free play. The proposed project would eliminate this use.

The La Crosse bikeway plan proposes a bike lane that would parallel the channel's upper reaches. A proposed bike path to Goose Island Park parallels a lower segment of the project (see plates 2-1 and 2-2). It would be possible to develop a bike path in conjunction with the proposed project which would incorporate portions of these bikeways and provide an additional link between them. During conversations with Corps planners, city officials have expressed an interest in investigating the proposed bike path further.

#### DEMAND FOR FACILITIES

The demand for bicycling facilities in La Crosse was derived from data contained in the 1977 SCORP. These data were given for Region 4, of which La Crosse is the major urban area. It was assumed that the per capita demand for facilities would be uniform throughout the region. La Crosse has approximately one-third of the region's population, and therefore would account for one-third of the regional needs. SCORP data indicate a 1980 demand for bikeways in the region of 155 miles, increasing to 180 miles in 1995. Thus, the 1995 demand in La Crosse would be for 60 miles of bikeway.

The SCORP also contains data on the number of bicycling occasions occurring within the region's resident population. Based on these data, it was determined that each mile of trail would accommodate an average of 1,840 occasions annually.

To determine the potential use of the bike path that could be developed as part of the flood control project, the bike path was divided into three segments. The lower segment could be part of the bike path to Goose Island Park. The park is very popular, with a number of day camps held during the summer, and this bike path would be heavily used. Therefore, for purposes of this analysis it was assumed that this segment would have twice the average per mile use (i.e., 3,680 occasions annually).



The upper segment parallels a proposed bike lane on a roadway labeled "scenic" in the Parks and Recreation Plan. The roadway is also a main collector for traffic in the upper coulee area and beyond. It would be used heavily by residents bicycling to work or school. This segment would also have twice the average use.

The middle segment would provide a more direct route between State Road Coulee and Goose Island Park. No bikeway was planned for this area. It is assumed that this segment would receive average use.

It was assumed that bicycling would grow 5 percent between 1990 and 1995, another 5 percent between 1995 and 2005, and again between 2005 and 2025. This 2025 level of use was held constant for the remainder of the project life. The following table shows the projected use of the bike path over the life of the project.

Segment	Projected recreational use					
	Visitor days					
	1985	1990	1995	2005	2025	2085
Lower segment (0.57 mile)	0	2,100	2,200	2,315	2,430	2,430
Middle segment (0.9 mile)	0	1,660	1,740	1,830	1,920	1,920
Upper segment (0.75 mile)	0	2,760	2,900	3,040	3,200	3,200
Total (2.2 miles)	0	6,520	6,840	7,185	7,550	7,550

#### COST OF DEVELOPMENT

The cost of the proposed bicycle path, as shown in the following table, was based on the following assumptions:

- Sufficient right-of-way for the bike path (15 feet wide) is available on project lands.
- No significant site work needs to be accomplished to build the path.
- The surface would be 2 inches of asphalt over a 4-inch aggregate base. The surface would be 8 feet wide.

Cost estimate for bicycle path <sup>(1)</sup>				
Item	Unit	Quantity	Unit cost	Total cost
Trail surface	LF	11,650	\$6.55	\$76,300
Signage	Job	Sum	200.00	200
Contingencies (20 percent)				<u>15,300</u>
Construction costs				91,800
Engineering				
Engineering and design (12 percent)				11,000
Supervision and administration				
Inspection (5 percent)				4,600
Overhead				
On E&D (13 percent)				1,400
On inspection (13 percent)				<u>600</u>
Total construction costs				109,400 <sup>(2)</sup>

(1) Based on October 1980 price levels - Estimating Section, Design Branch, St. Paul District, Corps of Engineers.

(2) Cost sharing for recreational development would be 50 percent Federal and 50 percent non-Federal. No extra land acquisition cost is involved.

#### ECONOMIC JUSTIFICATION

##### BENEFITS

The Unit Day Value method was used to assign benefits to the recreational use of the project. Guidance for the use of this method is contained in Engineering Regulation 1105-2-300, National Economic Development Benefit-Cost Analysis, dated 15 July 1980. The following table outlines the criteria and the values assigned.

Benefits		
Criteria	Values assigned	
1. Recreation experience	Total possible points:	30
	Points assigned:	5
Rationale: There are several areas existing or planned in the general vicinity of the project which would be accessible.		
2. Availability of opportunity	Total possible points:	18
	Points assigned:	4
Rationale: The planned bikeway system covers the entire city.		
3. Carrying capacity	Total possible points:	14
	Points assigned:	8
Rationale: The facilities would be designed using the current standards to ensure user safety and would be able to accommodate the anticipated usage.		
4. Accessibility	Total possible points:	18
	Points assigned:	10
Rationale: The access to the bike path would be good.		
5. Environmental quality	Total possible points:	20
	Points assigned:	3
Rationale: While the project area is rather pleasing, riding a bicycle beside a concrete channel would not be desirable.		
Total points		= 30
30 points translates into a recreation day value equal to \$1.68.		

The average annual recreation benefits were calculated with the aid of a computer program using the recreation day value determined above. At an interest rate of 7.375 percent and a 100-year project life, the average annual recreation benefits were estimated to be \$10,167.

#### COSTS

The average annual construction costs are derived by multiplying the total construction costs by the interest and amortization factor. Thus:

$$\$109,400 \times 0.07381 = \$8,074.81 \quad \$8,075.$$

27

The average annual maintenance costs are estimated by multiplying a "cost per day" value by the average annual use of the project. The bicycle path would require little in the way of daily or weekly maintenance. Therefore, a value of \$0.15 per user day was assigned. Given an average annual use of 7,093 users, the average annual maintenance costs are estimated to be \$1,065.

The average annual recreation cost is the total of the average annual construction costs plus the average annual maintenance costs, or:

$$\$8,075 + \$1,065 = \$9,140$$

#### BENEFIT-COST RATIO

The benefit-cost ratio for the proposed development is 1.11 (\$10,167 ÷ \$9,140).

#### IMPLEMENTATION

No recreational resource plan was included in the authorized plan. The recreation resource plan described in this appendix could be included in the project with a postauthorization change. The postauthorization change would be sent with appropriate recommendations to the Chief of Engineers for approval. This approach would be acceptable as long as the following three conditions were met:

1. The postauthorization change is processed before project construction.
2. No new lands are required for the change.
3. Local interests must advise the Corps of their willingness to pay the local costs of recreational development which would not exceed 50 percent of the total cost.

Guidelines for the postauthorization change are contained in Engineering Regulations 1105-2-31 and 1120-2-404.

## GLOSSARY OF TERMS

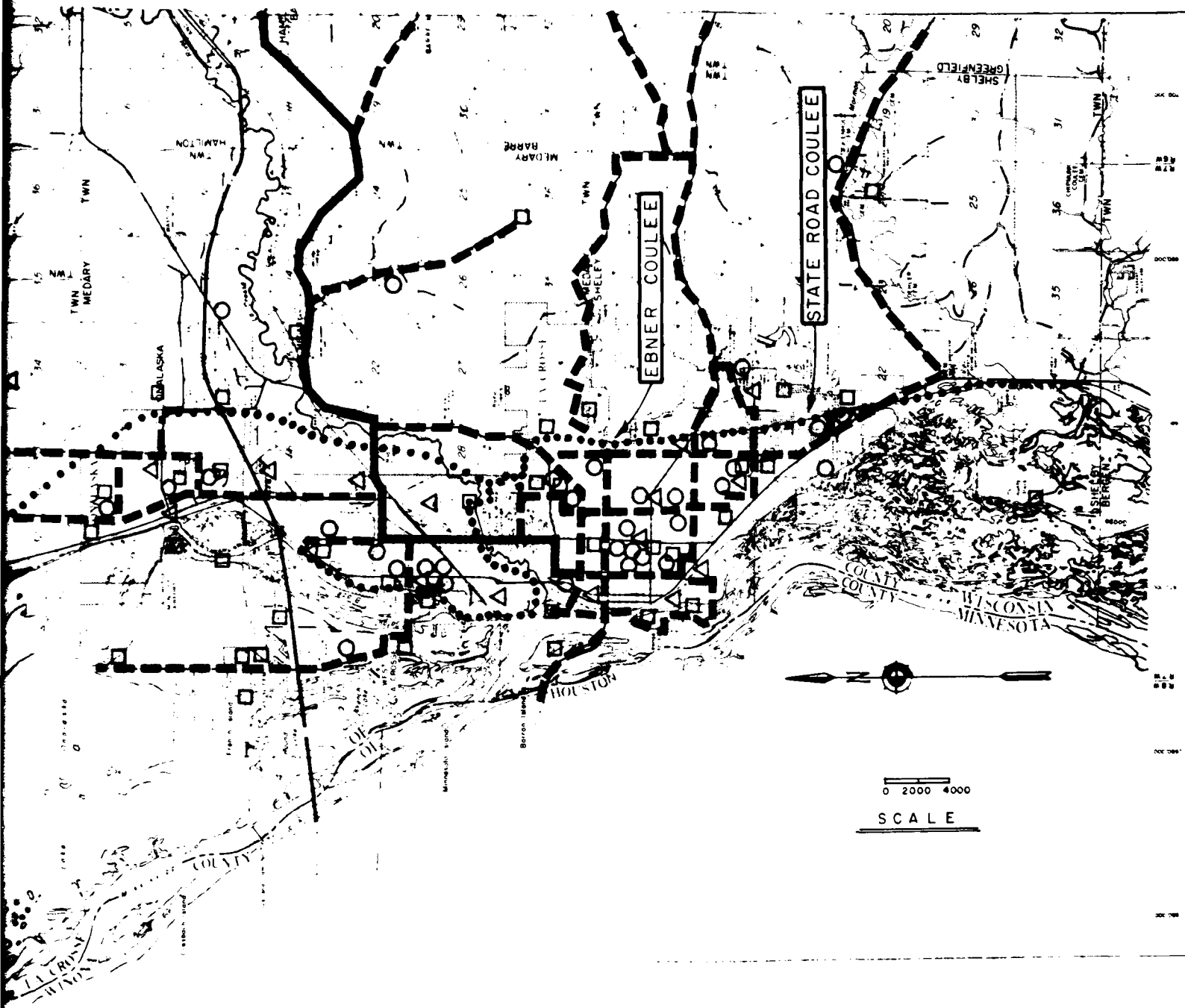
**Bikeway.** Any facility (road, path, etc.) designated for use by bicycles.

**Bike path.** A separate facility designated exclusively for bicycle use.  
Paths in park areas are a good example.

**Bike lane.** Portions of roadways designated for bicycle use. These lanes may be a part of existing or new construction and are usually stripped or signed. Curbing barriers are sometimes used also.

**Bike routes.** Signed roadways indicating good bicycle routes. (No special restrictions.)



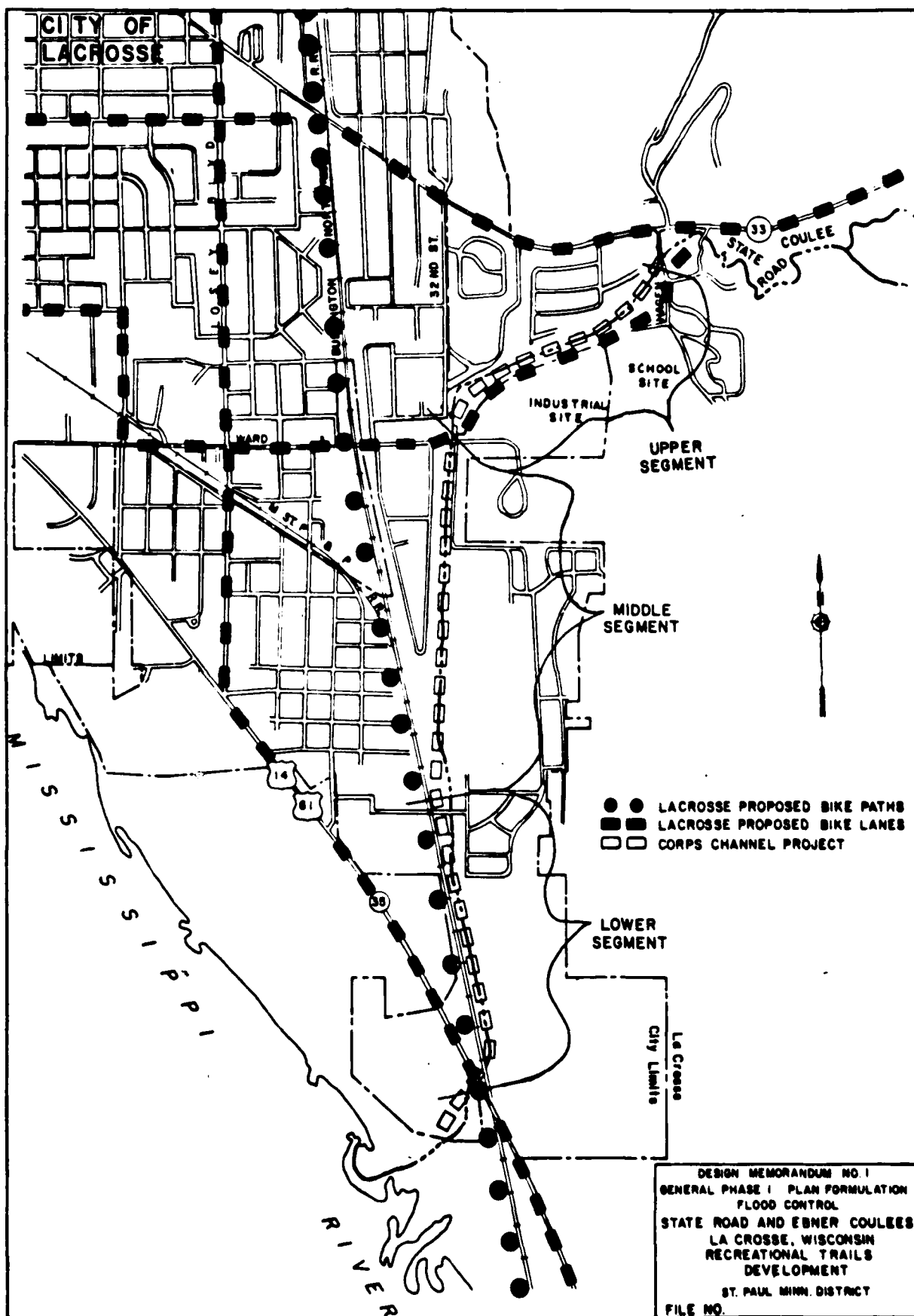


- BIKE LANES (PROPOSED)
- ..... BIKE PATHS (PROPOSED)
- WISCONSIN BIKEWAY (EXISTING)
- SCHOOLS
- PARK AND RECREATION AREAS
- △ COMMERCIAL AND INDUSTRIAL AREAS

LA CROSSE CITY PLANNING DEPARTMENT

DESIGN MEMORANDUM NO. 1  
 GENERAL PHASE I PLAN FORMULATION  
 FLOOD CONTROL  
 STATE ROAD AND EBNER COULEES  
 LA CROSSE, WISCONSIN  
**BIKEWAYS FOR THE  
 LA CROSSE AREA**  
 ST. PAUL MINN DISTRICT  
 FILE NO.

PLATE 2-1





HYDROLOGY

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PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

# HYDROLOGY

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### APPENDIX 3

#### HYDROLOGY

##### STREAMFLOW DATA

Because of the lack of flow records on both State Road and Ebner Coulees, synthetic methods were used to determine the frequency curves and hypothetical floods. The methods used to develop peak frequency values are discussed in later paragraphs. Data available from Gilmore Creek at Winona, Minnesota, were used to assist in establishing the synthetic parameters for small watersheds. Pertinent data for this station are shown in the following table.

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Stage and discharge data, Gilmore Creek at Winona

---

Location	6 1/2 miles upstream from mouth at west edge of Winona, approximately 30 miles northwest of La Crosse
Drainage area, square miles	3.95
Period of record	October 1939 to July 1965
Type of recorder	Continuous U.S. Geological Survey recorder
Maximum flow data:	
Date of occurrence	21 July 1951
Peak discharge, cfs	5,360(1)
Minimum flow data:	
Date of occurrence	Several days in July and August 1961
Minimum flow, cfs	0.4

---

(1) Estimated from an extended rating curve.

## FLOODS OF RECORD

From a high-water mark about 800 feet above Hagen Road bridge, a peak discharge of approximately 5,500 cfs has been computed by slope-area calculations for the flood of August 1959 on State Road Coulee. This flood resulted from a 4-hour rainfall measured in La Crosse at 4.7 inches, 4.69 inches of which was recorded in 2 hours. For comparative purposes, values of the 2-hour and 4-hour rainfalls for the 1-percent chance rainfall from Technical Paper No. 40 are 3.5 inches and 4.0 inches, respectively. Flood damage survey records show that minor flooding has occurred at Ebner Coulee during several years since 1955.

## FLOOD FREQUENCIES

Since streamflow data on State Road and Ebner Coulees are inadequate, the synthetic derivations used to determine peak discharges at several frequencies for State Road and Ebner Coulees are shown in the following tables.

Peak discharges for various synthetic methods applied to State Road Coulee

Frequency in years	Peak discharge (cfs)						
	Soil						Clark
	Bureau of Public Roads	Cook	Horton	Rational	Conservation Service	Survey Report	
10	1,950	2,420	1,700	3,060	2,910	1,350	Existing 2,440 Urbanized 2,830
25	2,550	2,550	2,600	3,480	3,600	2,500	3,300 3,800
50	3,000	4,260	3,400	3,910	4,170	3,750	4,150 4,550
100	3,500	5,200	4,420	4,260	4,700	5,500	5,000 5,340
500							7,200 7,500

Peak discharges for various synthetic methods applied to Ebner Coulee

Frequency in years	Bureau of Public Roads	Peak discharges (cfs)					
		Cook	Rational	Conservation Service	Survey Report	Clark	
						Existing	Urbanized
10	1,100	760	730	300	360	820	890
25	1,380	1,080	850	480	690	1,050	1,130
50	1,600	1,320	930	660	1,050	1,230	1,310
100	1,800	1,610	1,010	860	1,500	1,430	1,500
500						1,900	2,000

## BUREAU OF PUBLIC ROADS METHOD

This method, although primarily used in bridge and culvert design for a given flood frequency, yields realistic discharges for small drainage areas. The method uses plates to assist in determining topographic and precipitation indexes based on the location of the drainage area. Application of these indexes to nomographs yields peak discharges at 10- and 50-year frequencies. Peak discharges at other frequencies can be determined by plotting on log-probability paper. More complete analysis of this method can be found in the Bureau of Public Roads publication "Peak Rates of Runoff from Small Watersheds."

Parameters used in the Bureau of Public Roads method		
Location	Topographic index	Precipitation index
State Road Coulee	0.35	2 inches
Ebner Coulee	0.05	2 inches

## COOK METHOD

This method incorporates factors affecting runoff from small watersheds, including the relief, soil type, vegetative cover, and surface storage. This value, determined best after field survey, is applied over the drainage area and adjusted by rainfall and basin shape factors. Data pertaining to this method are shown in the following table.

Parameters used in the Cook method				
Location	Weighing factor	Rainfall factor	Length/width ratio	Shape factor
State Road Coulee	70	0.8	2.52	0.76
Ebner Coulee	73	0.8	2.0	0.84



The data supplied in the above table will yield the peak discharge for the 25-year frequency. Appropriate factors used to determine the 10-, 50-, and 100-year frequency peak discharges are 0.71, 1.23, and 1.50, respectively, times the 25-year value.

#### HORTON METHOD

According to the Department of the Army Technical Manual TM 5-820-1, this method is intended for use in designing airfields and heliports. As such, the slopes anticipated are less than the 3.7-percent slope found on State Road Coulee. However, good results were obtained in comparison with other methods shown in the table on page 3-3. The manual provides plates to reduce the flow length of the basin to an effective length at a slope of 1 percent. Also, Manning's "n" values are useful in determining the retardance coefficient of 0.22 for State Road Coulee.

#### RATIONAL METHOD

This method determines the amount of runoff by the formula  $Q = CiA$ , where  $Q$  is the maximum runoff rate in cfs,  $C$  is the runoff coefficient,  $i$  is the average rainfall intensity in inches per hour, and  $A$  is the drainage area in acres. The rational formula employs two basic assumptions. First, the rate of runoff is a function of the average rainfall intensity with no regard for the rainfall pattern during the storm. Second, the peak rate of rainfall is assumed to occur during the time of concentration. Although the rational method is used primarily in storm sewer design, it can be adapted to drainage areas as large as 5 square miles. The time of concentration was determined to be 53 minutes and the runoff coefficient was assumed to be 0.49 for State Road Coulee. These respective values for Ebner Coulee were 20 minutes and 0.41.

## SOIL CONSERVATION SERVICE METHOD

This method is based on the concept of representing hydrographs as triangular in shape. The dimensions of this triangle are as follows. The time to the peak of the triangle is determined to be one half the duration of rainfall excess plus 0.6 times the time of concentration. The peak discharge is found by the product of 484 times the drainage area, times the rainfall excess divided by the time to peak. The time base from the beginning of rainfall to end of recession is assumed to be 2.67 times the time to peak. Once the peak discharge for the unit hydrograph is established, its value is multiplied by the rainfall excess to determine the peak discharges for any frequency. Data used in this analysis are presented in the following table.

Parameters used in the Soil Conservation Service method				
Location	Time of concentration (hours)	Time to peak (hours)	Time base (hours)	Unit hydrograph peak (cfs)
State Road Coulee	0.88	1.03	2.75	2,200
Ebner Coulee	0.33	0.70	1.90	505

## SURVEY REPORT METHOD

The discharge-frequency curve shown in the Survey Report, dated 3 November 1967, was derived from the discharge-frequency curve for Gilmore Creek at Winona. The 0.7 power of the drainage area ratio was judged to be appropriate for this transfer.

## CLARK METHOD

The adopted discharge-frequency curve was derived from Clark's method, which fit well into the range of data generated from other synthetic methods (as shown in the tables on pages 3-3 and 3-4). The existing and urbanized condition discharge-frequency curves for State Road, Ebner and Miller Coulees are shown on plates 3-1 through 3-3. To analyze the adopted plan of improvement, routing procedures required the hydrologic study of Miller Coulee since it merges with Ebner Coulee before it discharges into the La Crosse River. Point rainfall came from the National Weather Service Technical Paper No. 40. Five storms for Gilmore Creek at Winona were analyzed to determine values of Clark's time of concentration and rainfall. These data are shown in the table below.

Pertinent data on unit hydrographs for Gilmore Creek near Winona

Date	Observed peak flow (cfs)	Direct runoff (in.)	Unit hydrograph peak flow (cfs)	Clark's method	
				Time of concentration (hrs.)	Rainfall (hrs.)
28 Jun 1942	2,250	0.425	5,250	1 3/4	1.13
31 Jul 1945	1,370	0.260	5,250	1 1/2	1.07
5 Nov 1945	1,070	0.192	5,300	-	1.28
27 Jul 1947	2,460	0.452	5,430	2	1.16
21 Jul 1951	5,360	1.02	5,270	1 1/2	1.10
Average				1 3/4	1.13

With Clark's time of concentration established as 1.75 hours and rainfall at 1.13 hours for Gilmore Creek, plate 3-4 was derived for State Road, Ebner, and Miller Coulees to determine Clark's rainfall based on the basin's area length (A/L) factor. This method is in accordance with paragraph 11 of an analysis of the Clark Method by Mr. Earl Meserve of the Kansas City District, dated 15 May 1963. This paragraph states in part "in such relations, the trend line (A/L vs. R plotted on log paper) tends to lay at 45 degrees."

The time of concentration was determined from the Kirpich equation adjusted for channel storage. This analysis considers the basin's characteristics including the watercourse length and basin relief. A summary of the Clark method parameters used is shown in the following table.

Clark method parameters for Gilmore Creek and State Road, Ebner and Miller Coulees

Parameters	Gilmore Creek	State Road Coulee (1)	Ebner Coulee (2)	Miller Coulee
Drainage area, square miles	8.95	4.54	0.73	1.02
Time of concentration in hours	1.75	1.25	0.33	0.33
Rainfall, in hours	1.13	0.87	0.44	0.45

(1) Station 39+50 (Hagen Road bridge).

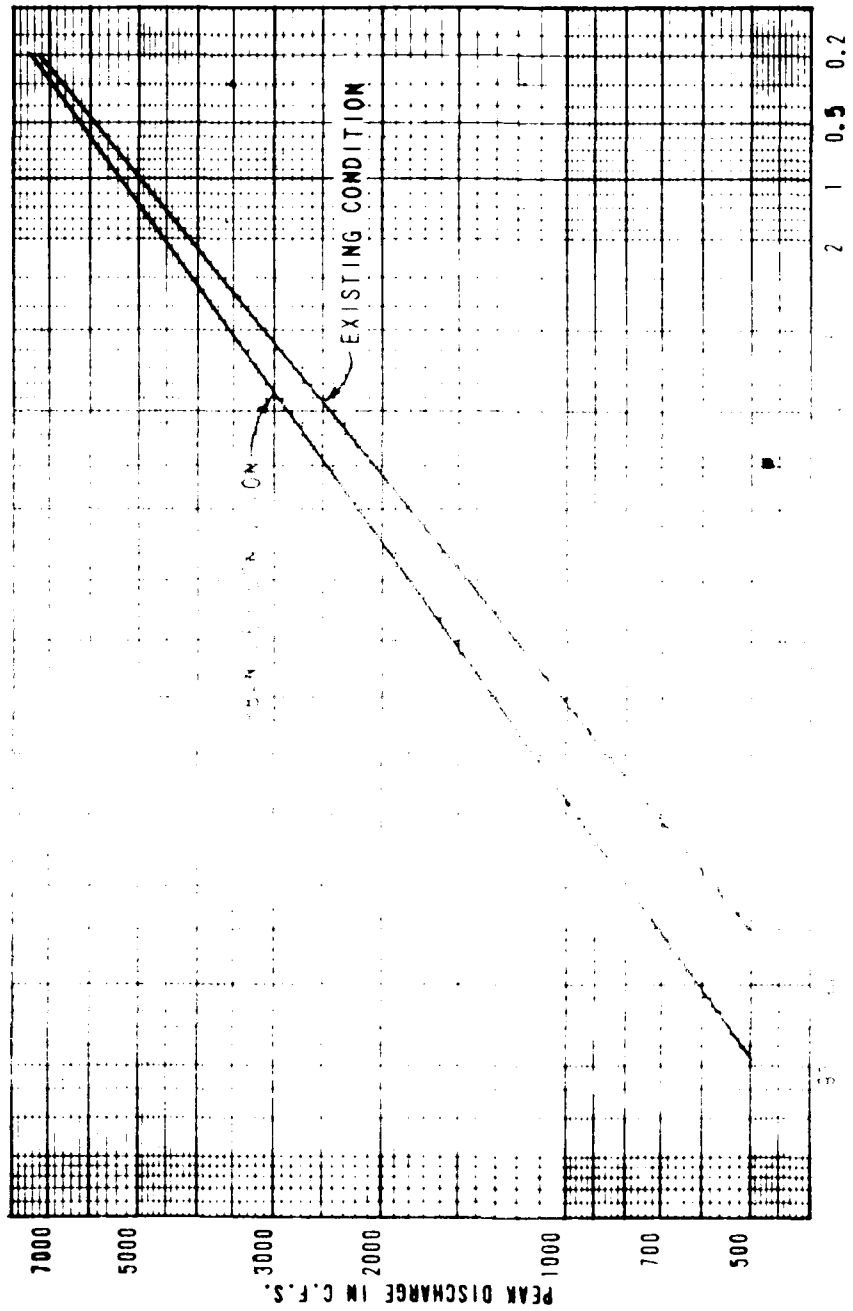
(2) Station 72+15 (29th Street).

#### STANDARD PROJECT FLOOD

The total rainfall for the standard project flood was determined from EM 1110-2-1411. Because of the short time of concentration involved in this study, the distribution of these rainfall values was modified to be consistent with Technical Paper No. 40. The rainfall excesses were applied to the adopted Clark unit hydrographs. The peak discharge for State Road Coulee was 9,750 cfs, while at Ebner Coulee the peak was 3,070 cfs. The unit hydrographs and 100-year flood hydrographs for State Road, Ebner, and Miller Coulees are presented on plates 3-5 through 3-7. Plates 3-8 and 3-9 show the standard project flood hydrographs for State Road and Ebner Coulees, respectively.

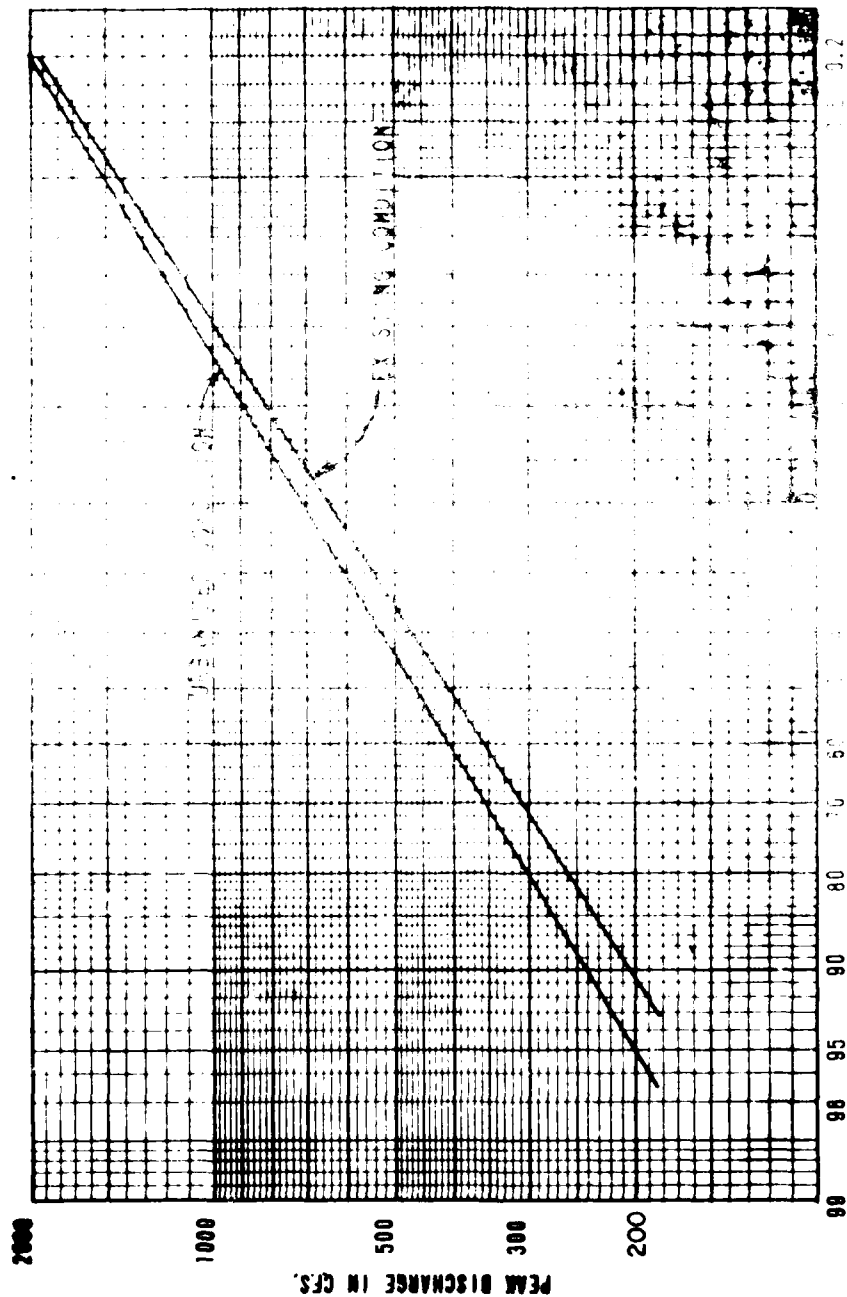
## EFFECTS OF URBANIZATION

The relatively steep slopes of the drainage basins will tend to have a lesser effect on urbanization than the increase in percentage of imperviousness may indicate. The basins were assumed capable of 50-percent development, with the loss rates adjusted accordingly. Peak discharges for State Road Coulee increased 16 percent at the 10-year frequency and 4 percent at the 500-year frequency because of urbanization effects, while Ebner Coulee figures were 9 percent and 5 percent, respectively. These results recognize that the major increases in discharge attributable to urbanization occur at the lower frequencies.



FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EDNER COULEE, WISCONSIN  
 DISCHARGE FREQUENCY CURVE  
 STATE ROAD COULEE AT HAGEN BRIDGE

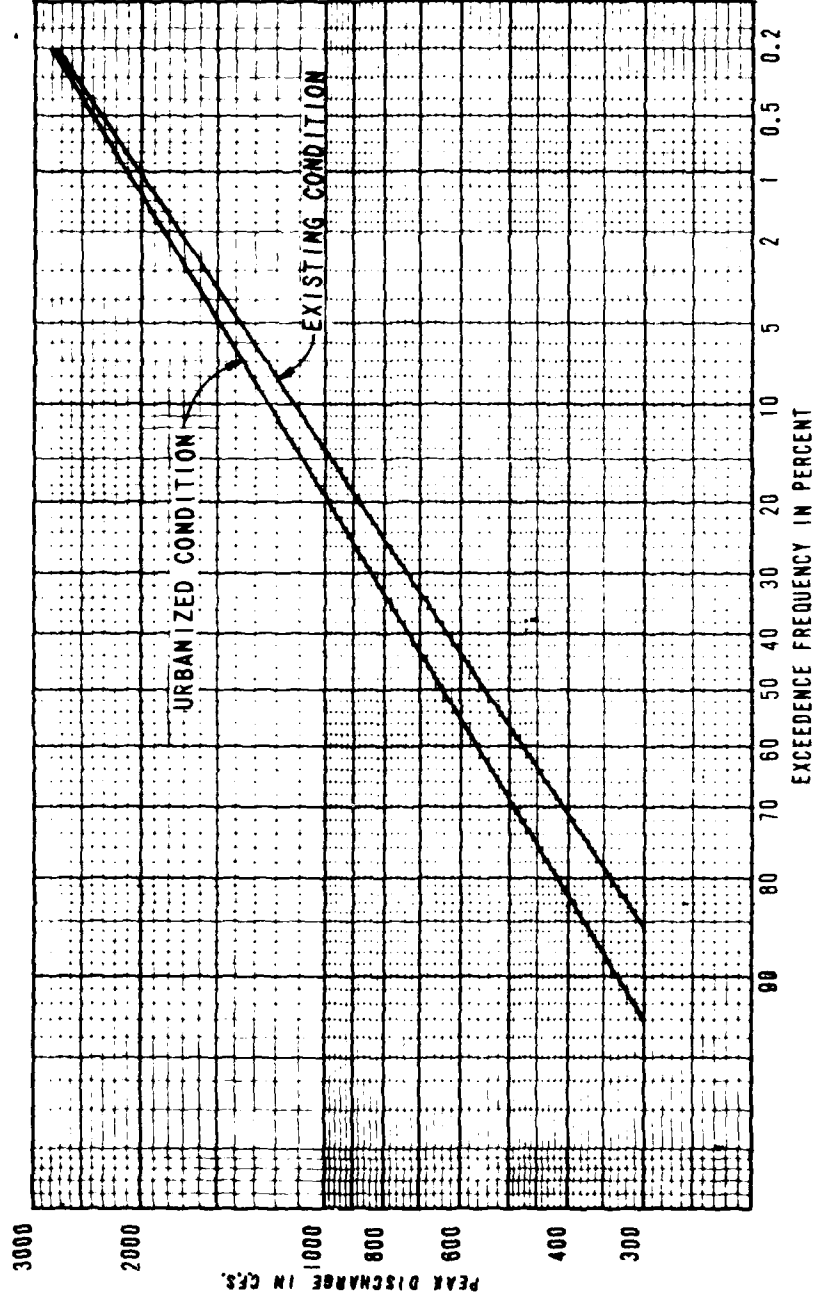
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FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EBMER COULEES, WISCONSIN

DISCHARGE-FREQUENCY CURVE  
 EBMER COULEE AT 29TH ST.

CT. MAP. DIST. CT. CORPS OF ENGINEERS  
 DATE: 1954



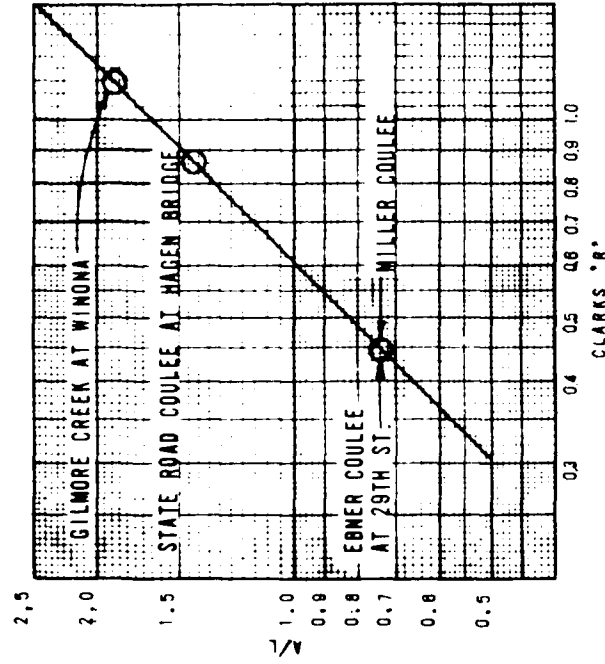
FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EBMER COULEES, WISCONSIN

URBANIZED CONDITION

DISCHARGE FREQUENCY CURVE  
 MILLER COULEE

ST. PAUL DISTRICT CORPS OF ENGINEERS  
 FILE NO. DATE:

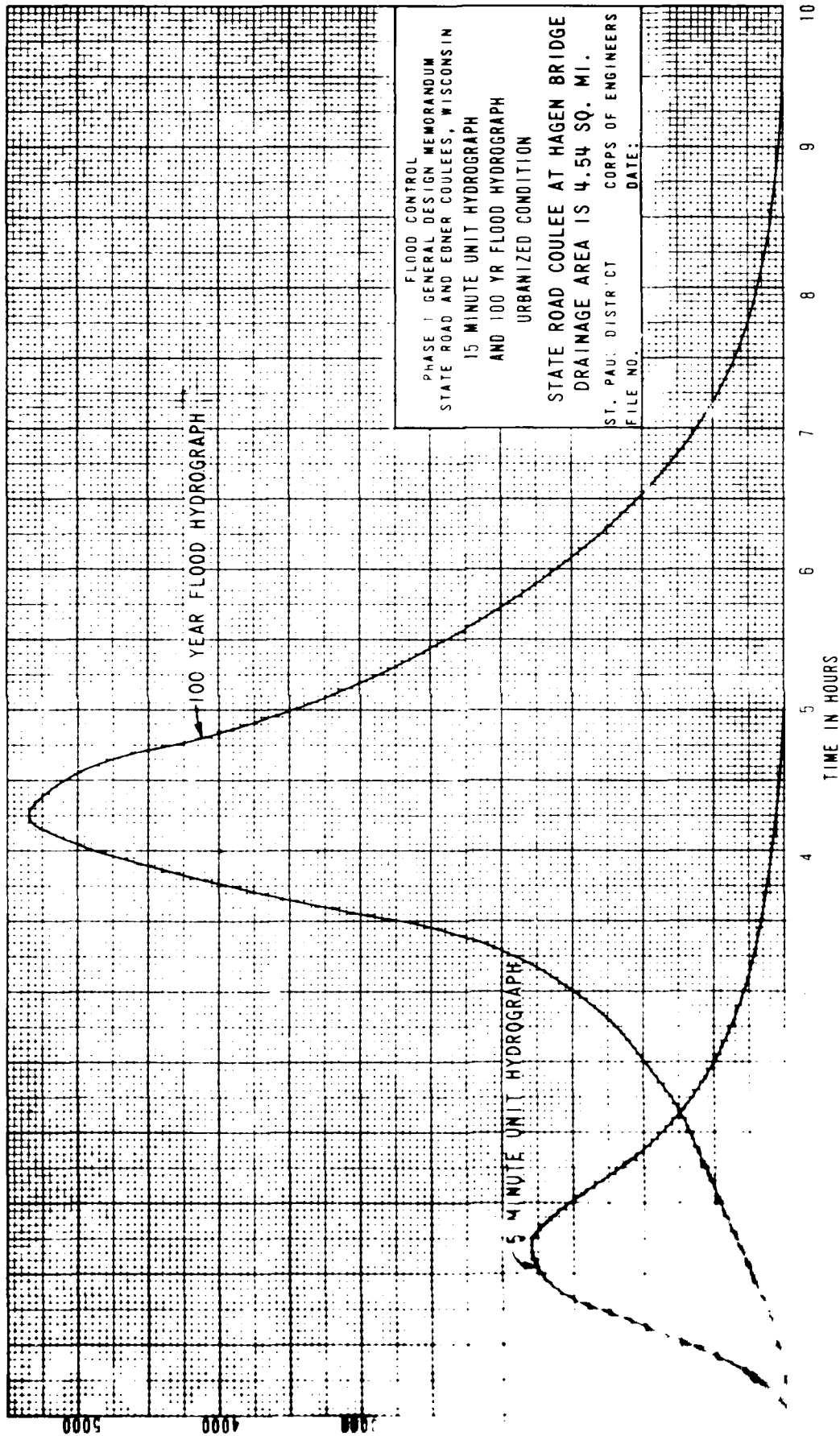




FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EDNER COULEES, WISCONSIN

CLARKS 'R' VS. A/L

ST. PAUL DISTRICT      CORPS OF ENGINEERS  
 FILE NO.      DATE:



FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EDNER COULEES, WISCONSIN  
 15 MINUTE UNIT HYDROGRAPH  
 AND 100 YR FLOOD HYDROGRAPH  
 URBANIZED CONDITION  
 STATE ROAD COULEE AT HAGEN BRIDGE  
 DRAINAGE AREA IS 4.54 SQ. MI.  
 ST. PAUL DISTRICT CORPS OF ENGINEERS  
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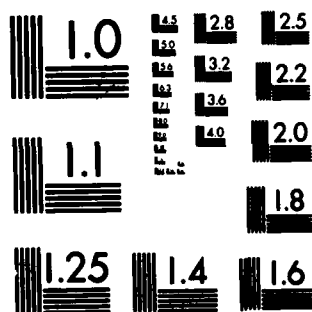
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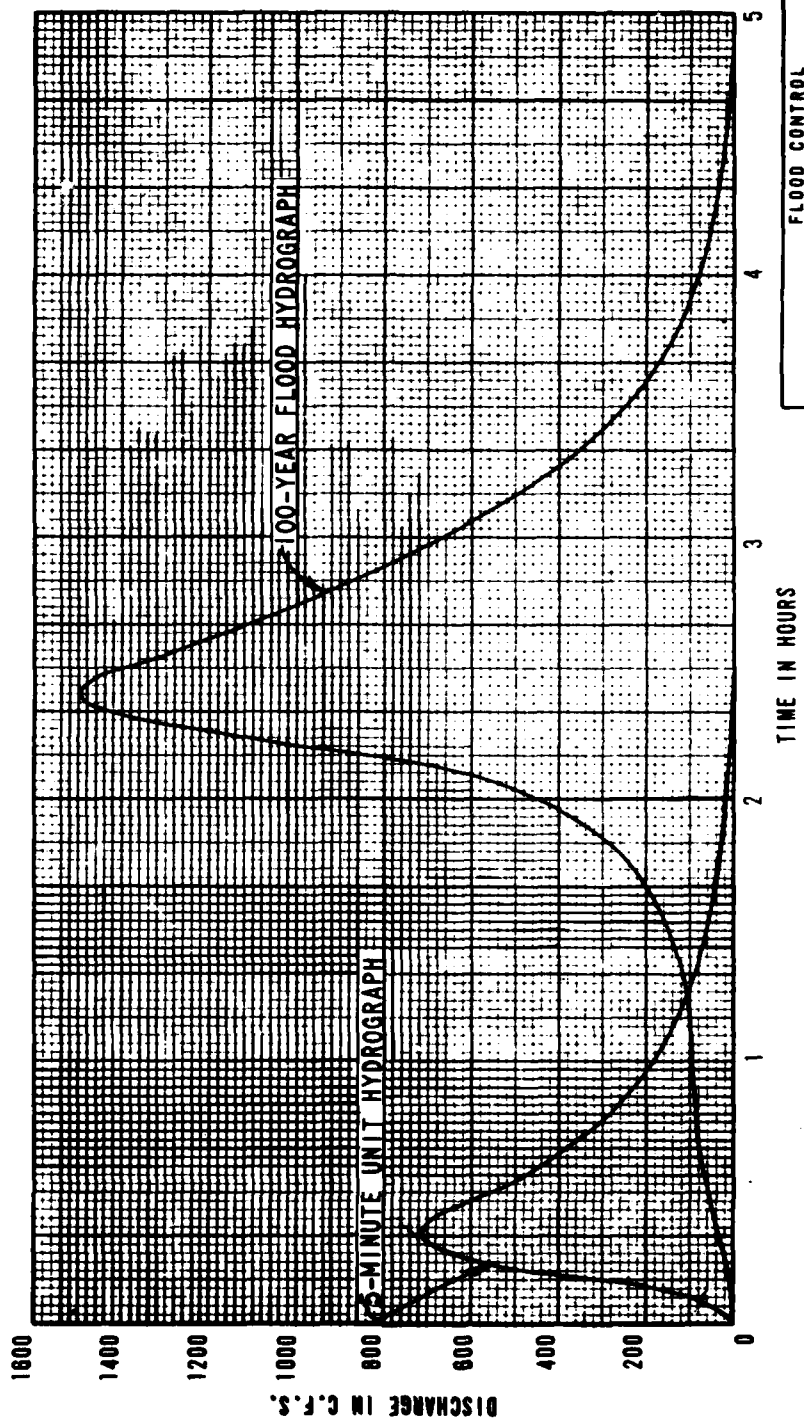
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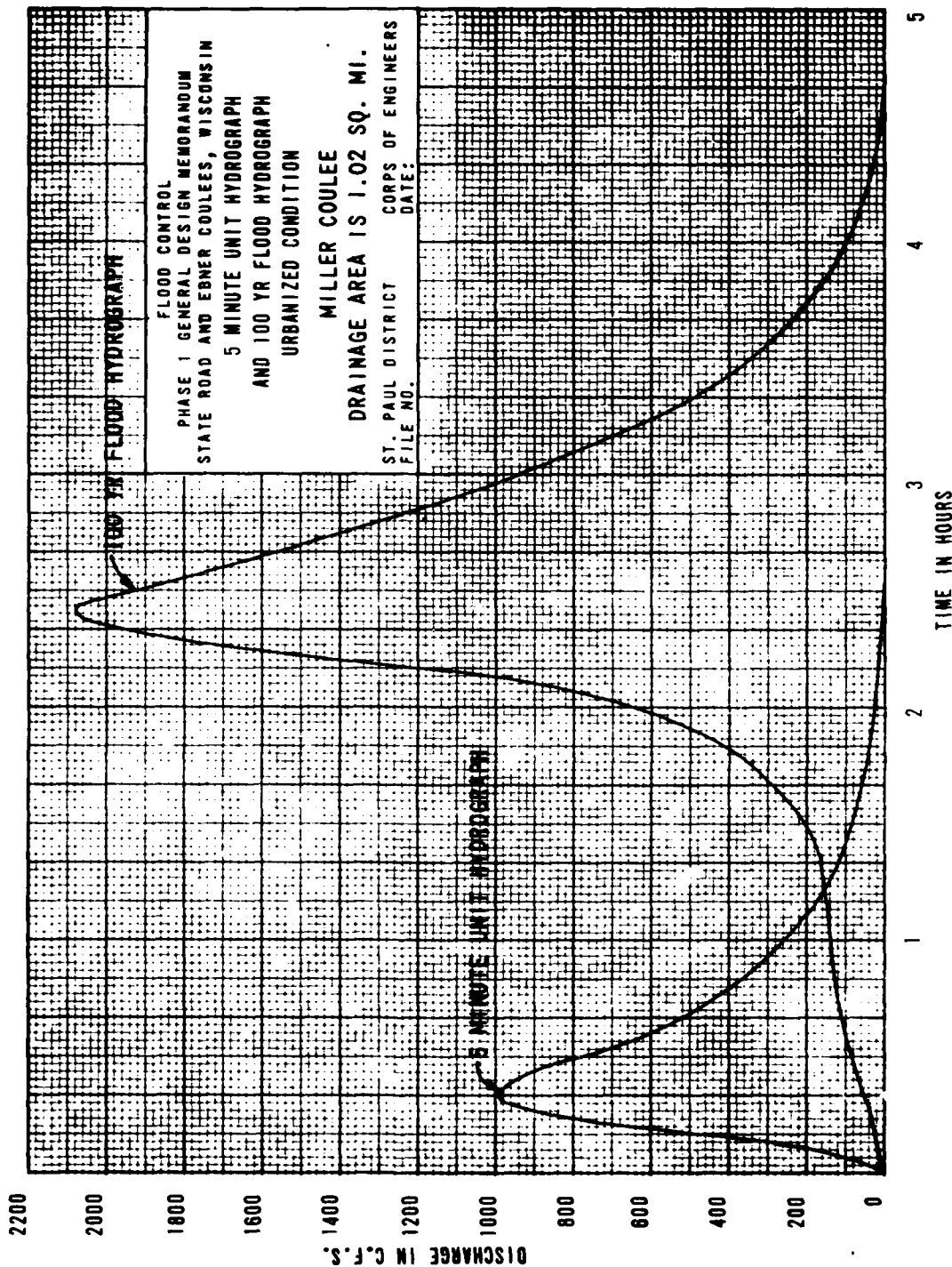


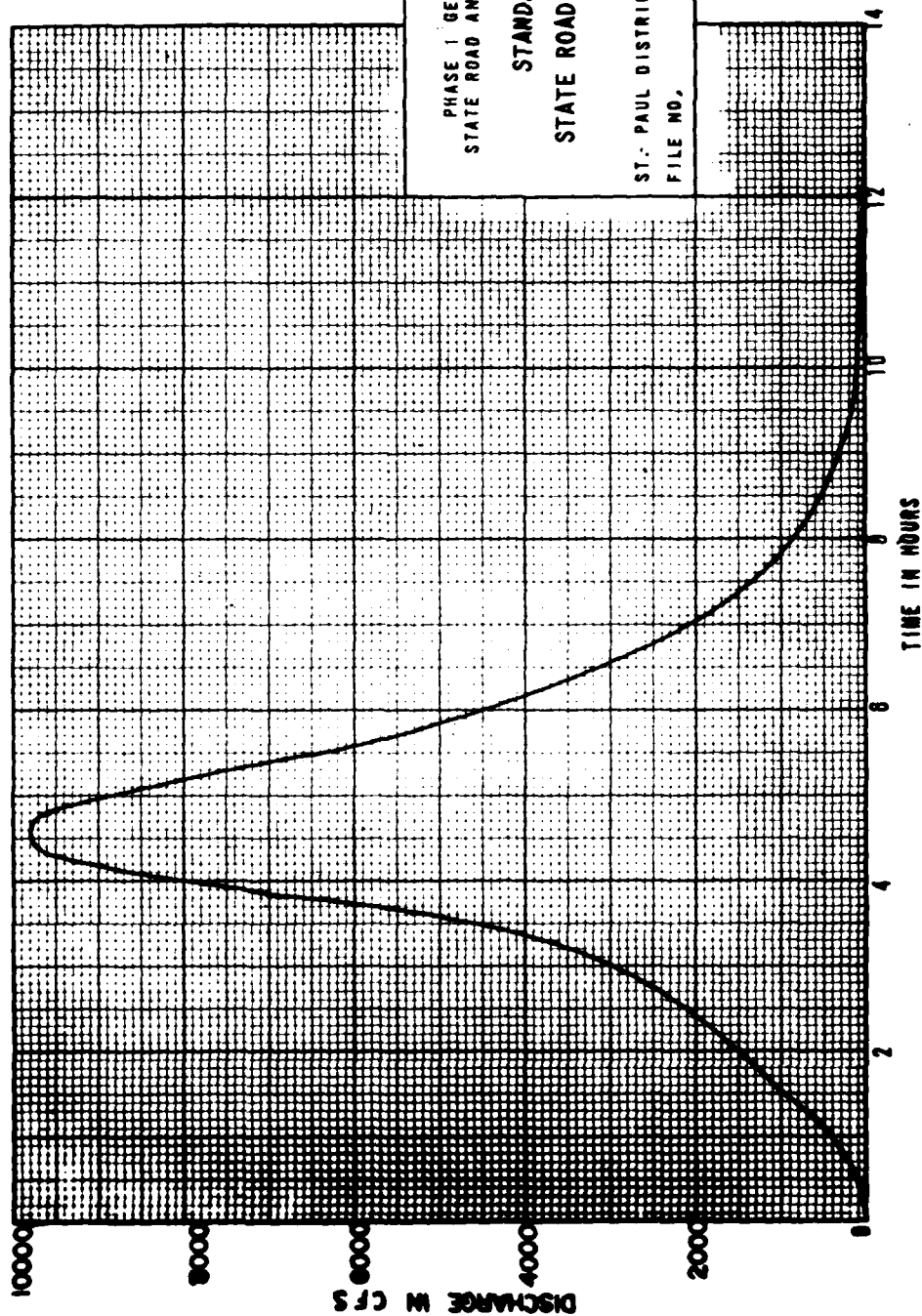


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EBNER COULEES, WISCONSIN  
 5 MINUTE UNIT HYDROGRAPH  
 AND 100 YR FLOOD HYDROGRAPH  
 URBANIZED CONDITION  
 EBNER COULEE AT 29TH ST.  
 DRAINAGE AREA IS 0.73 SQ. MI.  
 ST. PAUL DISTRICT CORPS OF ENGINEERS  
 FILE NO. DATE:

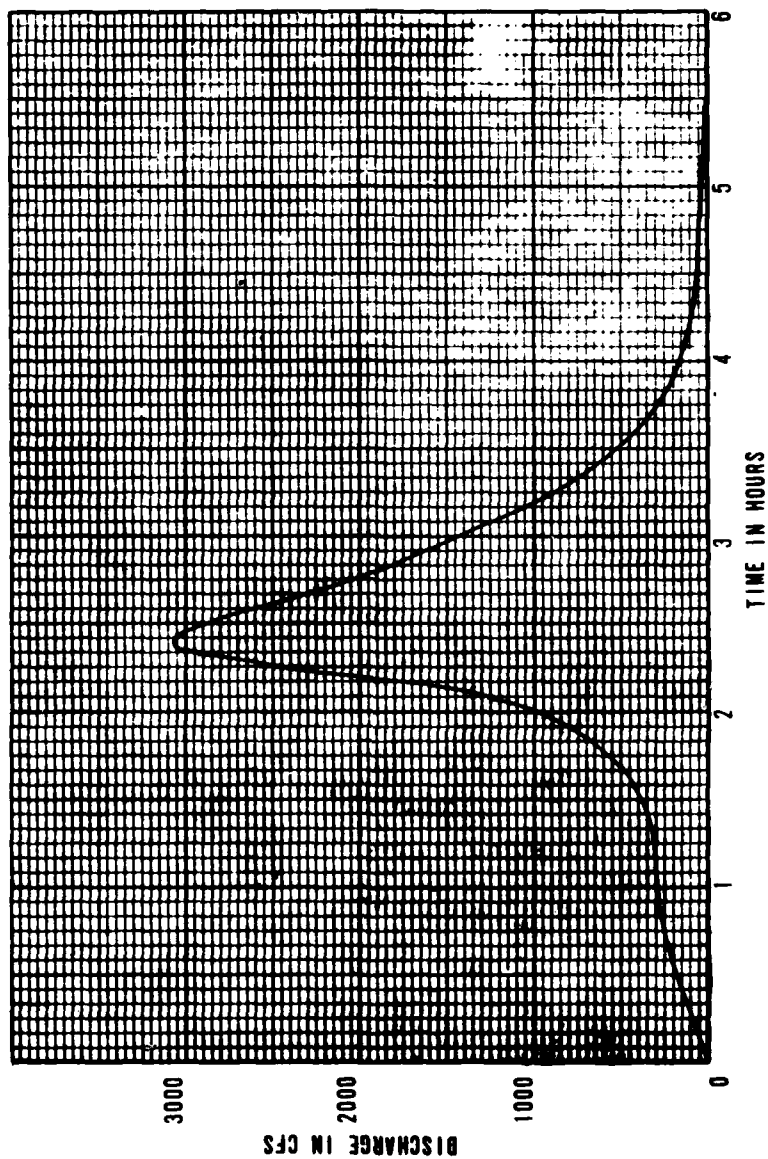




FLOOD CONTROL  
 PHASE I GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EBNER COULEES, WISCONSIN

STANDARD PROJECT FLOOD  
 STATE ROAD COULEE AT HAGEN BRIDGE

ST. PAUL DISTRICT      CORPS OF ENGINEERS  
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FLOOD CONTROL  
 PHASE 1 GENERAL DESIGN MEMORANDUM  
 STATE ROAD AND EBMER COULEES, WISCONSIN

STANDARD PROJECT FLOOD  
 EBMER COULEE AT 29TH ST.

ST. PAUL DISTRICT      CORPS OF ENGINEERS  
 FILE NO.                  DATE:



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PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

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## APPENDIX 4

### HYDRAULIC DESIGN

#### EXISTING CONDITION

##### CHARACTERISTICS OF THE EXISTING CHANNELS

Both Pammel Creek (lower portion of State Road Coulee is locally called Pammel Creek) from Hagen Road to the Burlington Northern railroad bridge near the Highway 14 and 16 overpass and Ebner Coulee from about 500 feet upstream of 29th Street to Farnam Street are leveed channels. The reach of Pammel Creek from Ward Avenue to the Burlington Northern railroad bridge and all of the leveed Ebner Coulee reaches are, essentially, perched channels (both sides of the overbank ground level are lower than the channel bottom).

Widths of the channels (distance between tops of left and right levees) are on the average 60 feet for Pammel Creek and 23 feet for Ebner Coulee. Depths of the channels (distance between the top of levee and the channel thalweg) are on the average 13 feet for Pammel Creek and 7 feet for Ebner Coulee. Some of the typical cross sections are shown on plates 4-1 and 4-2.

The capacity (threshold flow) of Pammel Creek upstream of Ward Avenue is about 1,100 cfs. The capacity of Ebner Coulee is approximately 400 cfs along the reaches running westward and about 130 cfs along the reaches running southward. When these flow rates are exceeded, floodwater can spill out of the main channel over the levees in both directions.

The existing levees for both channels appear to be fragile and are likely to be breached once they have been overtopped.

The rate of sedimentation is estimated as 1,125 cubic yards per year for the State Road Coulee area and 188 cubic yards per year for the Ebner Coulee area based on references 15 and 16.

## FLOW CONDITIONS

The flow conditions in the study area during a flood are unsteady due to significant breakout flows over the levees, nature of the fast flood wave movements and short duration of flooding, and the complex flow patterns in the overbank areas where flood storage is the dominant physical characteristic. Once flow separates from the main channel systems, it flows overland generally in a southward direction storing most of the flow in the residential areas on both sides of the channel and is prevented from reentering the main channel systems by the levees. General spill and overland flow patterns in the area are depicted in plate 4-3.

## METHOD OF ANALYSIS<sup>(1)</sup> IN DEVELOPING WATER SURFACE PROFILES

The modified Puls method of flood routing in the computer program HEC-1DB (reference 10) was utilized to trace the movement of the flood wave through the systems in lieu of the conventional HEC-2 (reference 11) step backwater method. Since spilled water from the main channel systems flows overland through the overbank residential areas independently, analyses were performed separately on the main channel and on the overbank systems.

The computer programs, HEC-2 (reference 11) and SPILL (reference 12), were used to develop the necessary rating tables for the modified Puls flood routing.

The program SPILL, a Steady State Spatially Varied Flow Analysis, which was specifically developed for the 1980 La Crosse Flood Insurance Study (reference 14), performs a steady flow step backwater computation similar to that performed by HEC-2 but, also, incorporates a calculation for the lateral outflows over the levees. The lateral outflow over the levee

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(1) The state-of-the art methodology presented here in developing water surface profiles was first formulated by Mr. John Peters of the Hydrologic Engineering Center for the 1980 La Crosse Flood Insurance Study under the contract order No. NCS-1A-79-68-ED-PB.

is computed in the program by the standard Weir formula  $Q = CAH^{1/2}$ , where Q, A, and H are discharge in cfs, flow area in square feet, and average flow depth in feet, respectively, over the levees between each pair of cross sections and C is the discharge coefficient.

The program SPILL was used to determine the relationships among stage and discharge in the main channel and spill discharge to the left and/or right overbanks at various locations along the main channel. In computing spill flow, levee failure was not considered.

The program HEC-2 was used to determine the relationships among stage, storage, and discharge for the routing reaches in the overbank areas.

The schematic operation sequence of HEC-1DB, SPILL, and HEC-2 models is depicted on plate 4-4. Computed water surface profiles for the 100-year and standard projects floods are shown on plates 4-5 and 4-6.

#### MODEL PARAMETERS AND BOUNDARY CONDITIONS

In developing water surface profiles, calibration of the models was not attempted because there were no usable flow data available in the study area and, therefore, all of the coefficients used in the computation were chosen based on engineering judgment.

An n-value of 0.04 and expansion and contraction coefficients of 0.3 and 0.1, respectively, were used throughout the reaches of SPILL sub-models for both Pammel Creek and Ebner Coulee main channels. A discharge coefficient of 2.7 was used for all weir flow calculations. Boundaries of geometric models were assumed rigid and, therefore, scour and deposition and levee failure were not considered.

Because the SPILL program does not have bridge routines, the bridge losses were computed separately using the HEC-2 special bridge routine wherever necessary.

An n-value of 1.0 was used in the residential area in the HEC-2 submodels for all overbank flow computations. The use of a high n-value, as opposed to showing the presence of houses with x-y coordinates on the cross section data, provided a means for limiting the conveyance in the residential area without eliminating storage. Whenever there was an open space such as a golf course, a NH card was used for the roughness description of that subsection of cross section.

All input hydrographs for the main channel routing submodels were obtained from the hydrology analysis in appendix 3. All input hydrographs for the overbank routing submodels were SPILL hydrographs determined by running the main channel routing submodels.

A time interval of 5 minutes was used in all routing computations.

## THE RECOMMENDED PLAN

### GENERAL

Various alternative channel modification plans described in the main report were developed and compared in order to select the most feasible plan. The selected plan is essentially a redesign of the authorized plan in the 1969 survey report with the exception of the degree of protection. This plan includes approximately 2.5 miles of channel modification for Pammel Creek from Hagen Road to the area near the mouth at the Mississippi River and about 1.6 miles of channel modification for Ebner Coulee diverting it north to the La Crosse River bottomlands. The plan does not include the alleviation of flooding from the Mississippi River, but only flooding from these two coulees. The Ebner Coulee plan was subsequently determined to be economically infeasible and, therefore, was not recommended for construction.

### DEGREE OF PROTECTION

The economically optimal design flow condition was determined based on the costs of three different channel modification plans formulated for 10-, 100-, and 300-year flow conditions. The magnitude of this optimal

22

flow was less than that of the 100-year flow. However, the channels of the recommended plan are designed to provide protection against floods up to the 100-year magnitude. A minimum of 2 feet of freeboard above the design water surface was generally provided.

#### FEATURES OF THE RECOMMENDED PLAN

The channel modification plan for Pammel Creek, shown on plates 5 through 10, consists of approximately 1 mile of supercritical, 1.3 miles of subcritical concrete-lined channels, and about 800 feet of riprap-lined channel. Also included are a drop structure, a stilling basin, a junction structure, three new street bridges, a new railroad bridge, and modification to sewer and water lines on State Road Coulee. The existing levees on State Road Coulee would be removed to enable surface runoff from the adjacent low-lying floodplain to drain directly into the channel. Design discharges shown on the profiles on plate 6 are for 100-year flow conditions.

#### IMPACT OF STANDARD PROJECT FLOOD

The standard project flood would be contained in the supercritical channel upstream of the stilling basin at station 86+85. However, for the subcritical channel downstream of station 86+85, the water surface profile would generally be 0.5 foot higher than the top of the side walls of the channel.

#### CHANNEL DESIGN

(STATE ROAD COULEE RECOMMENDED PLAN AND EBNER COULEE INFEASIBLE PLAN)

#### GENERAL

Hydraulic design computations were made based mainly on EM 1110-2-1601 (reference 1) and HDC (reference 5). In addition, references 2, 4, 7, 8, and 9 were also consulted especially in sizing the hydraulic structures. Backwater computations for the design channel were made using the HEC-2 computer program.



## CHANNELS

Design channel sizes and shapes are shown on plate 6. Design side slopes are 1.0 vertical to 2.0 horizontal for trapezoidal concrete-lined channels and 1.0 vertical to 3.0 horizontal for the trapezoidal riprap-lined channel. Design invert slopes are 0.0008 for subcritical channels and 0.006 for the supercritical channel.

The modified open channels that will convey flood flows on State Road Coulee were designed so the top of the channels would be below the surrounding natural ground except for the lower portion of State Road Coulee between station 21+00 and station 43+00 where further analysis to define needed additional drainage features will be conducted in phase I GDM studies. Therefore, no levees are required, and the freeboard provided above the design water surface is 2 feet. For the selected plan, a combination of trapezoidal concrete and riprap-lined channels is used throughout most of the alignment of State Road Coulee. At the lower end of State Road Coulee, where flow passes under the U.S. Highways 14 and 61 overpass and under the Burlington Northern railroad bridge, a rectangular concrete channel is proposed; a trapezoidal riprap-lined channel is provided at the downstream end of the project.

## TRANSITIONS

Wherever the channel changes in size and slope, transitions are provided. Although the detailed design of these transitions was not done for this report, determination of the approximate lengths and types was based on references 1 and 2. In the supercritical channel where the flow changes in direction, spiral transitions are also provided.

## SUPERELEVATION

The recommended plan also considered the effects of superelevation of the water surface at bends. Channel walls were heightened accordingly to account for these effects. The amount of superelevation, computed according

to criteria in EM 1110-2-1601 was about 1.6 feet, 1.5 feet, and 1.5 feet near stations 22+46, 107+40, and 127+70, respectively, on State Road Coulee. Spiral easement curves were included in the channel design at stations 107+40 and 127+70.

#### AIR ENTRAINMENT

Supercritical flow will occur in the upper reach of both coulees and at the lower end of Ebner Coulee. The selected plan allowed for air entrainment effects in these areas using hydraulic design criteria in EM 1110-2-1601, "Hydraulic Design of Flood Control Channels." It was found that these effects will be minor, the maximum stage increases being about 0.25 foot at the lower end of Ebner Coulee, and no additional freeboard was provided.

#### WATER SURFACE PROFILES

The design water surface profile for State Road Coulee was determined by backwater computations using the HEC-2 computer program. Values of Manning's "n" for these computations were selected as 0.013 and 0.035 for the design of the concrete and riprapped channels, respectively. Expansion and contraction losses used were generally 0.3 and 0.1, respectively, and 0.5 and 0.3, respectively, where transitions were located. The 10-year flood level on the Mississippi River was chosen as the starting water surface elevation at the mouth. The computed water surface profiles for the design and standard project flood conditions are shown on plate 6.

#### COINCIDENT FLOW CONDITIONS ON MISSISSIPPI RIVER

At the outlet of State Road Coulee, two conditions were assumed for the coincident water surface elevation on the Mississippi River - the flat pool level of 631.0 and the 10-year level of 638.2. It was expected that the flat pool condition would result in the more severe scour potential at the outlet of State Road Coulee, whereas the 10-year level would produce the maximum backwater effect.

In computing the design water surface for State Road Coulee, it was assumed that the coincident water surface elevation on the Mississippi River would be at a 10-year flood level. Severe floods in the small State Road Coulee basin have their origin in summer rains. Severe floods on the Mississippi River usually result from snowmelt. At nearby Winona, a 37-year period of record adjusted to 99 years by the St. Paul period of record lists only one flood (7 May 1954) of greater than 10-year magnitude which originated from other than snowmelt runoff. It was judged therefore that a 10-year coincident level on the Mississippi River would provide a reasonably conservative backwater condition at the mouth of State Road Coulee.

#### MISSISSIPPI RIVER FLOODING

The Mississippi River 1-percent chance flood elevation at the mouth of State Road Coulee is about 640.9 feet (msl, 1912 adjustment). Almost all of the residential land along State Road Coulee is above this level. The exceptions are a one-block square area along the east (left) bank of State Road Coulee, near Broadview Place and 33d Street, and an area less than one block square along the east (left) bank of State Road Coulee just upstream of the Burlington Northern railroad bridge.

The Mississippi River standard project flood elevation at the mouth of State Road Coulee is about 645.4 feet (msl, 1912 adjustment). Residential land on the left bank of State Road Coulee downstream of Meadow Lane Place (about station 72+00 along the channel center line of State Road Coulee) would be inundated by a flood of this magnitude.

Plate 4-7 shows flooded outlines for the Mississippi River 1-percent chance flood and standard project floods.

#### OUTLET OF STATE ROAD COULEE

Eight alternative channel alignments were considered in the design of the outlet of State Road Coulee. These alignments are discussed fully in the main report.

## OUTLET OF EBNER COULEE (INFEASIBLE - NOT RECOMMENDED)

At the outlet of Ebner Coulee, the flow was assumed to spread laterally on the La Crosse River bottomland after leaving the outlet channel and energy dissipating structures. The depth of flow on the bottomland around the structure was assumed to be about 1 foot, with the bottomland topography at an elevation of approximately 635.

## CONDUITS (INFEASIBLE - NOT RECOMMENDED)

For the Ebner Coulee plan, two 154- by 97-inch reinforced-concrete pipe arch conduits would convey the flow along Ebner Coulee from station 66+10 to the junction with Miller Coulee, station 17+65. These conduits were designed with the use of normal depth nomographs; that is, they were assumed to operate as open channels flowing partly full. The value of Mannings "n" was selected as 0.012 for the conduit design.

## HYDRAULIC STRUCTURES

### Upstream Terminus of the Modified Channel

At the upstream terminus of channel modification on both State Road and Ebner Coulees, a combination box inlet drop spillway and bridge is required to transfer design flows from the natural channels into the improved concrete channels. These structures were designed according to criteria given in Soil Conservation Service Manual 301, "Hydraulic Design of the Box Inlet Drop Spillway." Since the entering flow drops from the natural channel and flows downstream in the concrete channel at supercritical velocities, no stilling basin is needed.

### Change in Channel Grade

At the change in channel grade from steep to mild slope on both State Road and Ebner Coulees, a stilling structure is required to stabilize the location of the hydraulic jump that will form. This structure consists

simply of a concrete sill designed according to principles given in "Open Channel Hydraulics" by Ven Te Chow. A series of 8-inch drains is provided through the sill to prevent ponding of stagnant water behind the sill.

#### Outlet of Ebner Coulee

The flow velocity in the flume at the outlet of Ebner Coulee would be about 31 feet per second, too high to be withstood by riprap. Although the flow would spill out onto the La Crosse River bottomland and scour of this material would not be objectionable, the expected high velocity would probably generate strong eddies and swirls that would tend to undermine the end of the concrete flume. A stilling basin is, therefore, recommended at this outlet. It was designed according to criteria found in EM 1110-2-1602, "Hydraulic Design of Reservoir Outlet Structures."

#### Channel Junction Below Hagen Road Bridge

Side flow from a large corrugated-metal pipe joins the flow in State Road Coulee just downstream from Hagen Bridge. The design flow in the improved channel of State Road Coulee is supercritical at this point. A structure is, therefore, needed to provide smooth joining of the flows so that objectionable cross waves will not develop and overtop the channel sides. Criteria for the design of this junction structure were obtained from EM 1110-2-1601.

#### Junction of Ebner and Miller Coulees

Another hydraulic structure is called for at the junction of Ebner and Miller Coulees. The upstream portion of the structure, which admits flow from Miller Coulee, was designed according to Soil Conservation Service Manual 301. The downstream portion of the structure provides for a bridge for the Burlington Northern railroad tracks and for entry of the flow from the Ebner Coulee conduits.

## Bridges

In general, existing bridges were found to have substandard roadway widths and inadequate waterway openings and clearance for safe passage of design flood flows. Considering these factors, plus the fact that most of these bridges are in poor structural condition, it was assumed that new bridges would be installed at Hagen Road (station 138+69), Drive-In Road (station 116+65), Broadview Plaza (station 53+60), and the Burlington Northern railroad crossing (station 21+46) on State Road Coulee. The existing single span box culvert at U.S. Highway 16 on Ebner Coulee (station 7+02) requires enlargement to include two additional spans. The proposed new bridges would conform to Wisconsin Highway Department design standards for roadway width, and some would have a walkway width of 6 feet. Low steel would clear design water surface levels by at least 3 feet at all bridges except those at Broadview Plaza and the Burlington Northern railroad crossing on State Road Coulee. The clearance at the Broadview Plaza bridge was set at 2.5 feet because of problems with the approach grade and excessive cost to get the preferred 3 feet. At the Burlington Northern railroad bridge the elevation of the tracks limited the clearance to 2.3 feet.

The bridges at Hagen Road, Drive-In Road, Entrance Road, 29th Street, and Park Drive require clear spans so that the supercritical flows at these locations will pass unobstructed. The design flow through the bridges at U.S. Highways 14 and 61 and at the Burlington Northern railroad on State Road is subcritical and these bridges have piers. There is no flow contraction since the bridge openings are the same size and shape as the adjacent channel. The backwater caused by the piers was estimated by using HEC-2 computer program. Data pertaining to existing bridges and proposed modifications are listed on the following table.

Appendix 4  
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Bridge data												
Bridge	Design discharge (cfs)	Clear span abutment (feet)	Number of piers	Channel bottom elevation		Design width of water surface (feet)	Bottom		Existing low member	Design low member	Required modification	
				Natural	Improved		water channel	member				
State Road Coulee (Recommended plan)												
Hagen Road	5,850	18	0	673.2	673.4	683.5	18	687.3	688.4	Remove and replace		
Drive-In Road	5,850	40	0	662.2	657.2	663.0	18	Unknown	668.3	Remove and replace		
Broadview Plaza	6,030	72	0	644.5	685.5	645.3	30	652.7	647.8	Remove and replace		
Burlington Northern Railroad bridge	6,230	80	1	636.4	632.8	641.7	80	644.1	644.0	Remove and replace		
Ebner Coulee (Plan not recommended)												
Entrance Road	1,490	16	0	683.1	680.2	684.4	16	687.7	687.3	Remove and replace		
29th Street	1,490	16	0	664.0	654.9	658.4	16	669.5	668.0	Remove and replace		
Burlington Northern Railroad bridge	3,180	30	0	650.1	644.9	652.4	30	656.1	657.9	Remove and replace		
Highway 16	3,180	3x8-foot box	-	643.0	643.2	649.2	24	651.0	651.0	Add two 8x8-foot box culverts		
Park Drive	3,140	30	0	639.7	639.7	643.2	30	Unknown	650.0	Remove and replace		

## RIPRAP

Riprap is required at the entrance structures and the outlets of State Road and Ebner Coulees, at the entrance structure at the junction of Ebner and Miller Coulees, downstream from the Burlington Northern railroad bridge, and upstream from the U.S. Highway 16 box culverts on Ebner Coulee. Riprap was designed according to criteria outlined in EM 1110-2-1601, "Hydraulic Design of Flood Control Channels," ETL 1110-2-120, "Additional Guidance for Riprap Protection," and HDC 712-1, "Stone Stability, Velocity vs. Stone Diameter." The required riprap thickness and gradations are listed in the following table.



Location	Design velocity (fps)	Riprap design		Riprap gradation	
		Riprap layer thickness (inches)	Percent lighter by weight	Limit of stone weight in pounds	
Entrance structure State Road Coulee(1)	10	18	100 50 15	292 - 117 86 - 58 43 - 18	
Entrance structure Ebner Coulee (2)	10	18	100 50 15	292 - 117 86 - 58 43 - 18	
Entrance structure Miller Coulee (2)	10	18	100 50 15	292 - 117 86 - 58 43 - 18	
Outlet, State Road(1) Coulee	7.7	12	100 50 15	86 - 35 26 - 17 13 - 5	
Outlet, Ebner Coulee(2)	11.8(3)	36	100 50 15	2,333 - 933 691 - 467 346 - 146	
Downstream Burlington Northern Railroad Bridge Ebner Coulee (2)	13.6	30	100 50 15	1,350 - 540 400 - 270 200 - 84	
Upstream U.S. Highway 16 Ebner Coulee (2)	5.7	12	100 50 15	86 - 35 26 - 17 13 - 5	

(1) Recommended plan.

(2) Plan not recommended.

(3) Velocity over end sill of stilling basin, high turbulence assumed.

## PROJECT IMPACTS AND FUNCTIONAL OPERATION

In the unimproved channel upstream of Hagen Road where the drop structure is proposed, an M-2 water surface profile is expected. Because of the M-2 drawdown curve induced by the project, a higher velocity (compared to that under the existing condition's M-1 water surface profile) will occur in the unimproved channel. To prevent the possible erosion potential, adequate riprap protection and smooth transitions will be provided. The extent of riprap protection in the unimproved channel, however, was not computed in detail for this report.

The proposed channel was generally designed in such a way that the surface runoff from the adjacent low-lying floodplain would drain directly into the channel. However, the surface runoff from the residential area west of Pammel Creek and between Ward Avenue and Highway 33 cannot be collected in the proposed channel because of the natural topography. The runoff from this area should be collected and drained by the existing storm sewer system.

Because of the concentrated flow situation at the downstream terminus of improvement (1-percent chance flood discharge of 6,230 cfs for the design condition versus the 1-percent chance flood discharge of 1,310 cfs for existing condition), a greater scour potential near the mouth of Pammel Creek at the Mississippi River will be created by the project. However, the terminating structure will be designed in such a way that this scour potential will be minimized and the flow beyond this structure will spread on to the Mississippi River floodplain.

## FURTHER STUDY NEEDED

### UPSTREAM TERMINUS OF THE MODIFIED CHANNEL

At the upstream terminus of improvement, a slope transition, i.e., a chute spillway type, may be preferable to the proposed drop structure at Hagen Road.

## PHYSICAL MODEL STUDY

In order to complete the design for the approximate mile-long supercritical channel, a physical model study may be necessary because of uncertainties in flow behavior with respect to the junction structures, two flow directional changes, and trapezoidal sections on curves. The Waterways Experiment Station and other Districts will be contacted and, if designs have been developed which are compatible to assure that the proposed or modified design will function adequately, a physical model study will not be required. Also, a further detailed study is necessary for the stilling basin at the transition between the supercritical and the subcritical channel.

## OUTLET OF STATE ROAD COULEE

At the downstream terminus of improvement, a different type of terminating structure should be studied to minimize the erosion potential outside of that structure. Also, the location of this structure should be reconsidered so that a favorable transition between the design channel invert and the natural channel bottom can be attained. In order to lower the design water surface in the vicinity of the Burlington Northern railroad bridge, it is recommended that the terminating structure be located near station 5+00 or 6+00, if environmentally acceptable.

## FLOOD INSURANCE STUDY PROFILES

The existing condition flood insurance study stream profiles are listed in the following tables:

- Tables 4-1 through 4-4 - the computed water surface elevations in the main channels of Pammel Creek and Ebner Coulee, respectively.
- Tables 4-7 through 4-10 - the peak spill discharges and spill flow volumes leaving the main channel stem at specified routing reaches.

The tabulated profiles were also the basis for the current phase I GDM analysis. The profile stationing is shown on plate 4-8. Note that all the elevations in the phase I GDM study were based on the 1912 adjustment. The flood insurance levels can be corrected to the 1912 adjustment by adding approximately one-half foot.

Table 4-1 - Computed Water Surface Elevations  
in the Main Channel of Pammel Creek  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Location	Reach Length (feet)	Thalweg Elev. (feet)	Water Surface Elevations					Standard Project Flood
				10-year (10-percent chance) Flood	50-year (2-percent chance) Flood	100-year (1-percent chance) Flood	500-year (0.2-percent chance) Flood		
1.00		-	637.4	645.3	645.4	645.4	645.4	645.4	645.4
1.04	B.N. RR Bridge	29	637.4	646.5	646.6	646.6	646.6	646.6	646.6
1.56		520	636.4	647.3	647.4	647.4	647.4	647.4	647.4
2.56		1000	639.1	649.1	649.3	649.3	649.3	649.3	649.3
3.66	N. Edge of Golf Cs.	1100	640.9	651.6	651.9	651.9	651.9	651.9	651.9
4.16		500	643.0	652.7	653.1	653.1	653.1	653.1	653.1
4.22		60	642.2	652.8	653.2	653.2	653.2	653.2	653.2
4.26	Broadview Pl. Br.	37	642.3	653.1	653.7	653.7	653.7	653.7	653.7
5.19		928	647.0	654.8	655.3	655.3	655.3	655.3	655.3
6.06		872	648.3	657.4	657.7	657.7	657.7	657.7	657.7
6.86		800	650.5	659.6	659.9	659.9	659.9	659.9	659.9
7.91		1050	652.6	662.7	663.0	663.0	663.0	663.0	663.0
8.59		680	654.8	664.7	665.0	665.0	665.0	665.0	665.0
8.69		100	655.0	665.0	665.3	665.3	665.3	665.3	665.3
8.79		100	655.6	665.3	665.6	665.6	665.6	665.6	665.6
8.85		60	655.8	665.5	665.8	665.8	665.8	665.8	665.8
8.93	New Ward Av. Br.	80	656.2	665.6	665.9	665.9	665.9	665.9	665.9
9.00		70	656.6	665.6	665.9	665.9	665.9	665.9	665.9
9.19		190	657.6	665.9	666.2	666.3	666.3	666.3	666.3
9.66		460	658.7	666.7	667.0	667.1	667.1	667.1	667.1
9.73		80	659.6	666.8	667.2	667.3	667.3	667.3	667.3
9.88		155	660.3	668.0	668.4	668.5	668.5	668.5	668.5
10.01		155	660.7	669.2	669.6	669.7	669.7	669.7	669.7
10.15		155	661.1	670.4	670.8	670.9	670.9	670.9	670.9
10.29		160	662.3	671.6	672.1	672.2	672.2	672.2	672.2
10.34	Drive-In Rd. Br.	45	662.3	673.0	674.0	674.1	674.1	674.1	674.1
10.53		194	663.4	673.5	674.5	674.6	674.7	674.7	674.7
10.54	Foot Bridge	10	663.4	673.6	674.6	674.7	674.8	674.8	674.8
10.77		245	666.8	674.2	675.3	675.5	675.6	675.6	675.6
11.57		850	668.5	679.1	681.2	681.8	682.3	682.3	682.3
12.29		810	673.8	684.0	685.7	686.4	687.6	688.3	688.3
12.41		155	674.6	684.9	686.6	687.3	688.6	689.5	689.5
12.46	Hagen Rd. Br.	50	674.8	685.6	689.9	690.7	691.8	692.3	692.3

Table 4-2 - Computed Water Surface Elevations  
in the Left Overbank of Pammel Creek  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Location	Reach Length (feet)	Thalweg Elev. (feet)	Water Surface Elevations					Standard Project Flood
				10-year (10-percent chance) Flood	50-year (2-percent chance) Flood	100-year (1-percent chance) Flood	500-year (0.2-percent chance) Flood		
1.0	Calvert Road	-	640.7	641.9	642.9	643.7	644.2	645.3	
11.0	S. Abut, Hwy 14661 overpass	2055	630.0	642.8	644.2	645.1	645.5	646.7	
1.82	N. Marion Street	1530	642.6	643.2	644.5	645.4	645.8	646.9	
3.66	N. Edge of Golf Cs.	1790	644.7	645.9	646.6	647.0	647.2	647.8	
4.92	Birch Street	1280	643.3	647.4	648.7	649.5	649.9	650.9	
6.01	Meadow Lane	1075	644.4	648.8	650.4	650.9	651.3	652.2	
7.53	Park Lane	1530	650.5	653.4	654.3	654.3	654.6	654.8	
8.58		1050	654.2	659.5	660.2	660.3	660.5	661.0	
8.68	Ward Avenue	100	663.9	665.2	665.6	665.7	665.8	666.1	
10.15	Drive-In Road	1550	672.4	-(1)	673.1	673.3	673.4	673.7	

Note: (1) No spill occurs at this reach.

Table 4-3 - Computed Water Surface Elevations  
for the portion of right overbank area of  
Pamuel Creek between 30th Street and Hagen Road  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Location	Reach Length (feet)	Thalweg Elev. (feet)	Water Surface Elevations				
				10-year (10-percent chance) Flood	50-year (5-percent chance) Flood	100-year (1-percent chance) Flood	500-year (0.2-percent chance) Flood	Standard Project Flood
160	30th Street	-	655.0	655.5	656.3	656.5	657.0	658.9
190	31st Street	300	657.5	658.0	659.3	659.9	660.7	661.2
220	32nd Street	300	663.0	663.3	664.7	665.3	666.2	666.9
242	Shorewood Dr.	220	663.2	663.8	665.7	666.3	667.4	668.4
290	200' W. of Drive-In Road	480	663.6	665.7	666.7	667.2	668.4	669.5
325	Redwood Court	350	669.9	(1)	670.9	671.6	672.5	673.1
405	Hiawatha Ave.	800	674.2	(1)	675.8	676.5	678.3	679.0
473	Hagen Road	700	688.2	(1)	(1)	689.3	690.0	691.0

Note: (1) No spill occurs at these reaches.

Table 4-4 - Computed Water Surface Elevations  
in the main channel of Ebner Coulee  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Location	Reach Length (feet)	Thalweg Elev. (feet)	Water Surface Elevations				Standard Project Flood
				10-year (10-percent chance) Flood	50-year (2-percent chance) Flood	100-year (1-percent chance) Flood	500-year (0.2-percent chance) Flood	
136	Farnum Street	--	650.2	658.3	658.4	659.0	659.0	660.1
129.5		650	650.8	658.8	658.8	659.2	659.3	660.1
122		750	654.0	659.7	659.7	659.7	659.7	660.1
116.8		520	656.3	661.6	661.6	661.7	661.7	661.7
110		680	660.4	665.5	665.5	665.5	665.6	665.6
105.6		540	665.2	669.9	670.0	670.0	670.1	670.2
105	29th St. Culvert	60	665.2	670.4	670.6	670.6	670.7	670.9
100		500	669.0	674.8	675.3	675.5	675.9	676.3



Table 4-2 - Computed Water Surface Elevations  
in the right overbank of Elmer Coulee  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Location	Reach Length (feet)	Thalweg Elev. (feet)	Water Surface Elevations				
				10-year (10-percent chance) Flood	50-year (2-percent chance) Flood	100-year (1-percent chance) Flood	500-year (0.2-percent chance) Flood	Standard Project Flood
103	Farnum Street	-	657.6	658.7	659.9	659.0	659.0	660.1
104	Cottage Grove	680	654.0	658.7	659.1	659.2	659.3	660.1
105	Jackson Street	600	657.0	659.1	659.3	659.3	659.4	660.1
107	Jordan Place	650	655.7	659.2	659.9	660.1	660.4	661.7
108	Cliffwood Lane	500	658.6	-(1)	660.5	660.8	661.3	663.0
	90 degree turn							
1.0	B.N. RR track	200	658.7	-(1)	660.7	661.2	661.8	663.6
2.0	29th Street	500	661.4	-(1)	661.8	661.9	662.1	663.8
2.5		300	664.4	-(1)	665.2	665.4	665.8	665.9
3.0		200	668.6	-(1)	669.1	669.2	669.4	670.2

Note: (1) No spill occurs at these reaches.

Table 4-6 -- Computed Water Surface Elevations  
for the right overbank of Pammel Creek  
south of Ward Avenue and for the left  
overbank of Ebner Coulee  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Location	Reach Length (feet)	Thalweg Elev. (feet)	Water Surface Elevations				
				10-year (10-percent chance) Flood	50-year (2-percent chance) Flood	100-year (1-percent chance) Flood	500-year (0.2-percent chance) Flood	Standard Project Flood
1.90(1)	600' south of trailer court	-	641.5	(2) 643.3	643.5	643.6	643.6	643.6
				(3) 646.5	646.6	646.6	646.6	648.2
3.66	N. Edge of trailer court	1800	646.6	-(4)	-(4)	648.0	649.1	651.0
4.22	Broadview Place	700	651.0	-(4)	-(4)	651.4	652.6	655.1
5.38	Leonard Street	1180	648.7	651.1	651.3	651.6	653.0	656.3
6.00	Highland Avenue	630	647.8	651.1	651.4	651.6	653.0	656.4
6.86	Glass Street	820	647.2	651.3	651.7	652.2	653.1	656.7
7.85	Brookshire Place	1000	650.5	652.1	652.7	653.0	653.4	657.2
8.68		780	652.0	653.3	653.8	653.8	654.2	657.9
8.91	Ward Avenue	150	655.8	-(5)	-(5)	655.9	656.8	658.6
11.51	Ivy 33	3800	652.2	653.9	655.9	656.8	657.7	658.9
101	Greenbay Street	60	652.2	654.5	656.1	656.9	657.7	658.9
102	Denton Street	750	653.5	656.3	657.3	657.9	658.8	659.9
103	Farnum Street	550	657.6	658.3	658.4	658.6	659.0	660.1
104	Cottage Grove	680	653.8	658.3	658.4	658.6	659.0	660.1
106	Jackson Street	750	657.0	658.5	659.4	659.7	660.3	661.0
107	Jordan Place	500	657.5	659.8	660.7	661.0	661.6	662.3
108	Cliffwood Lane	500	660.3	663.0	663.5	663.6	664.0	664.4

Note: (1) Water surface elevations at cross-section 1.90 were due to backwater from the main channel of Pammel Creek.  
 (2) Water surface elevations at the west side of the Burlington Northern railroad tracks.  
 (3) Water surface elevations at the east side of the Burlington Northern railroad tracks.  
 (4) Floodwater originating from the Ward Avenue bridge was contained in the residential area above Broadview Place.  
 (5) Floodwaters originating from Ebner Coulee and from the right overbank of Pammel Creek above Ward Avenue were stored in the residential area between U.S. Highway 33 and Ward Avenue.

Table 4-7 - Summary of Spill Analysis  
along the Main Channel  
for 10-percent chance flood

Section Number	Location	Main Channel Flow			Left Spill from the reach		Right Spill from the reach	
		Volume (ac-ft)	Peak Flow (cfs)	Elev (ft)	Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)
PAIMEL CREEK								
12.46	Hagen Road	354	2440	685.6	0	0	0	0
11.57	Hiawatha Ave.	354	2440	679.1	0	0	0	0
10.77	Near Redwood Ct	354	2440	674.2	0	0	5	130
10.29	Drive-In Road	349	2310	671.6	61	730	15	200
8.85	Ward Avenue	272	1370	665.5	0	0	0	0
1.56		272	1370	647.3	7	90	34	250
1.04	B.N. RR Bridge	231	1020	646.5				
	Total Volume of Spill =				68		54	
FRNER COULEE								
94		59	820					
100		59	820	674.8	0	0	0	0
110	90 degree Bend	47	450	665.5	12	350	-	-
136	Parnum Street Storm Sewer	24	130	658.4	1	5	33	310
	Total Volume of Spill =				13		33	

Table 4-8 - Summary of Spill Analysis  
along the Main Channel  
for 2-percent chance flood

Section Number	Location	Main Channel Flow			Left Spill from the reach		Right Spill from the reach	
		Volume (ac-ft)	Peak Flow (cfs)	Elev (ft)	Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)
Pammel Creek								
12.46	Hagen Road	642	4080	689.9	0	0	15	380
11.57	Hiawatha Ave.	627	3690	681.2	0	0	0	0
10.77	Near Redwood Ct.	627	3690	675.3	5	80	58	680
10.29	Drive-In Road	565	2930	672.1	142	1100	41	340
8.85	Ward Avenue	382	1450	665.8	0	0	0	0
1.56		382	1450	647.4	17	140	50	260
1.04	B.N. RR Bridge	314	1040	646.6			164	
		Total Volume of Spill =			164			
Ebner Coulee								
94		102	1240		0	0	2	70
100		100	1170	675.3	31	650	2	50
110	90° Bend	67	470	665.5	1	5	36	320
136	Farnum St. Storm Swr	31	130	658.4				
		Total Volume of Spill =			32		40	

Table 4-9 - Summary of Spill Analysis  
along the Main Channel  
for 1-percent chance flood

Section Number	Location	Main Channel Flow			Left Spill from the reach		Right Spill from the reach	
		Volume (ac-ft)	Peak Flow (cfs)	Flew (ft)	Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)
Pannel Creek								
12.46	Hagen Road	1043	5000	690.7				
11.57	Hiawatha Ave.	978	3940	681.8	0	0	66	1020
10.77	Near Redwood Ct.	976	3900	675.5	2	40	0	0
10.29	Drive-In Road	871	3020	672.2	10	110	95	760
8.85	Ward Avenue	586	1460	665.8	220	1200	64	350
1.56		586	1460	647.4	0	0	0	0
1.04	B.N. RR Bridge	479	1050	646.6	27	150	80	260
		Total Volume of Spill =			259		305	
Ebner Coulee								
94		129	1430					
100		126	1300	675.5	0	0	3	130
110	90° Bend	81	470	665.5	42	760	3	60
136	Farnum St Storm Swr	40	130	659.0	1	5	40	330
		Total Volume of Spill =			43		46	

Table 4-10 - Summary of Spill Analysis  
along the Main Channel  
for 0.2-percent chance flood

Section Number	Location	Main Channel Flow		Left Spill from the reach		Right Spill from the reach	
		Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)	Volume (ac-ft)	Peak Flow (cfs)
PAYTEL CREEK							
12.46	Hagen Road	1382	7200				
				4	80	249	2900
11.57	Hiawatha Ave.	1128	4120				
				10	110	3	40
10.77	Near Redwood Ct.	1115	3970				
				17	120	136	790
10.29	Drive-In Road	963	3060				
				266	1300	80	390
8.85	Ward Avenue	615	1465				
				0	0	0	0
1.56		615	1465				
				33	150	85	260
1.04	B.N. RR Bridge	496	1050				
	Total Volume of Spill =			330		553	
EBNER COULEE							
94		183	1950				
				0	0	11	350
100		172	1600				
				61	1000	5	110
110	90 degree Bend	106	490				
				1	5	52	350
136	Farnum Street Storm Sewer	53	135				
	Total Volume of Spill =			62		68	

Table 4-11 - Computed Peak Stages in the Left Overbank of Pammel Creek  
with various encroachment cases for a 1-percent chance flood

Section number	Location	Distance	Existing Condition		Case B2		Case 14		Case 11		Case 12		Case 13		Case B4	
			Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width	Elev	Width
1	Calvert Rd.	0	643.7	406	643.7	406	643.8	406	643.8	406	643.9	406	643.8	406	643.8	406
4		865	644.3	409	644.3	409	644.4	409	644.4	409	644.5	409	644.4	409	644.4	409
8		1,695	644.9	470	644.9	230	645.0	230	645.0	230	645.1	230	645.0	230	645.0	230
0		1,995	645.1	460	645.2	130	645.2	130	645.3	130	645.3	130	645.2	130	645.3	130
1	S. abutment of Hwy 14 & 61 overpass	2,060	645.1	465	645.2	120	645.2	120	645.3	120	645.3	265	645.2	365	645.3	120
3		2,550	645.2	511	645.3	420	645.3	420	645.4	420	645.4	320	645.3	420	645.4	420
5		2,950	645.3	455	645.4	350	645.4	350	645.5	350	645.5	255	645.4	355	645.5	350
1.82	N. Marion St.	3,585	645.4	550	645.5	370	645.6	370	645.6	370	645.6	340	645.5	440	645.6	370
2.56		4,325	646.1	580	646.2	400	646.3	400	646.3	400	646.3	380	646.1	480	646.3	400
3.66	N. Edge of Golf Co.	5,375	647.0	925	647.2	400	647.2	400	647.2	400	647.4	725	647.0	825	647.3	400
4.60	Kenton St.	6,335	648.6	1100	648.7	1100	648.8	1000	648.8	900	648.8	900	648.6	1000	648.8	1000
5.06	Birch St.	6,835	649.5	1200	649.5	1200	649.6	1100	649.7	1000	649.6	1000	649.5	1100	649.6	1100
5.38	Leonard St.	7,160	650.0	1275	650.0	1275	650.1	1175	650.2	1075	650.1	1075	650.0	1175	650.2	1175
5.72	Robinsdale Ave.	7,490	650.5	1260	650.6	1260	650.6	1160	650.7	1060	650.7	1060	650.5	1160	650.7	1160
6.01	Meadow Lane	7,770	650.9	1140	651.0	1140	651.0	1040	651.1	940	651.1	940	650.9	1040	651.2	1040
6.86		8,630	652.8	690	652.9	690	652.9	590	653.0	490	653.0	490	652.9	590	652.9	240
7.53	Park Lane	9,300	654.3	480	654.4	480	654.4	480	654.4	480	654.4	480	654.4	480	654.3	480
7.85		9,620	656.1	680	656.2	680	656.2	680	656.2	680	656.2	680	656.2	680	656.1	680
8.58		10,350	660.3	340	660.3	340	660.3	340	660.3	340	660.3	340	660.3	340	660.3	340
8.68	Hard Ave.	10,450	665.7	340	665.7	340	665.7	340	665.7	340	665.7	340	665.7	340	665.7	340

Note: (a) Width is measured:

- (1) from the center line of left levee of Pammel Creek to the flooded outline
- between cross-section 15 and cross-section 8.68, and
- (2) from the east side of railroad track to the flooded outline between cross-section 1 and cross-section 14.

(b) Encroachment cases are depicted in Plate 3.

Table 4-12 - Bridges and Culverts  
(All elevations refer to National Geodetic Vertical Datum of 1929)

Section Number	Description	Distance (Feet)	High Chord Elev. (Feet)	Low Chord Elev. (Feet)	Opening Area (Ft <sup>2</sup> )	Span (Feet)	Width (Feet)
<b>Pammel Creek</b>							
0.89	Farm Bridge	0	645.2	643.8	141	21	18
1.04	Burlington N. Railroad Bridge	149	647.0	643.3	133	42	28
4.26	Broadview Place bridge	3,366	654.8	652.0	242	40	31
8.93	New Ward Ave. bridge	8,036	665.1	663.0	600	107	62
10.34	Drive-In Road bridge	9,506	673.0	671.2	282	58	37
10.54	Foot bridge	9,710	674.4	672.9	352	88	4
12.46	Hagen Road bridge	11,820	688.2	686.7	286	28	44
<b>Ebner Coulee</b>							
136	Farnum Street Storm Sewer	0	657.5	654.5	14	52-inch RCP	
105	29th Street Arch Culvert	3,100	673.8	672.3	61	10'-11"x7'1" C&PA	



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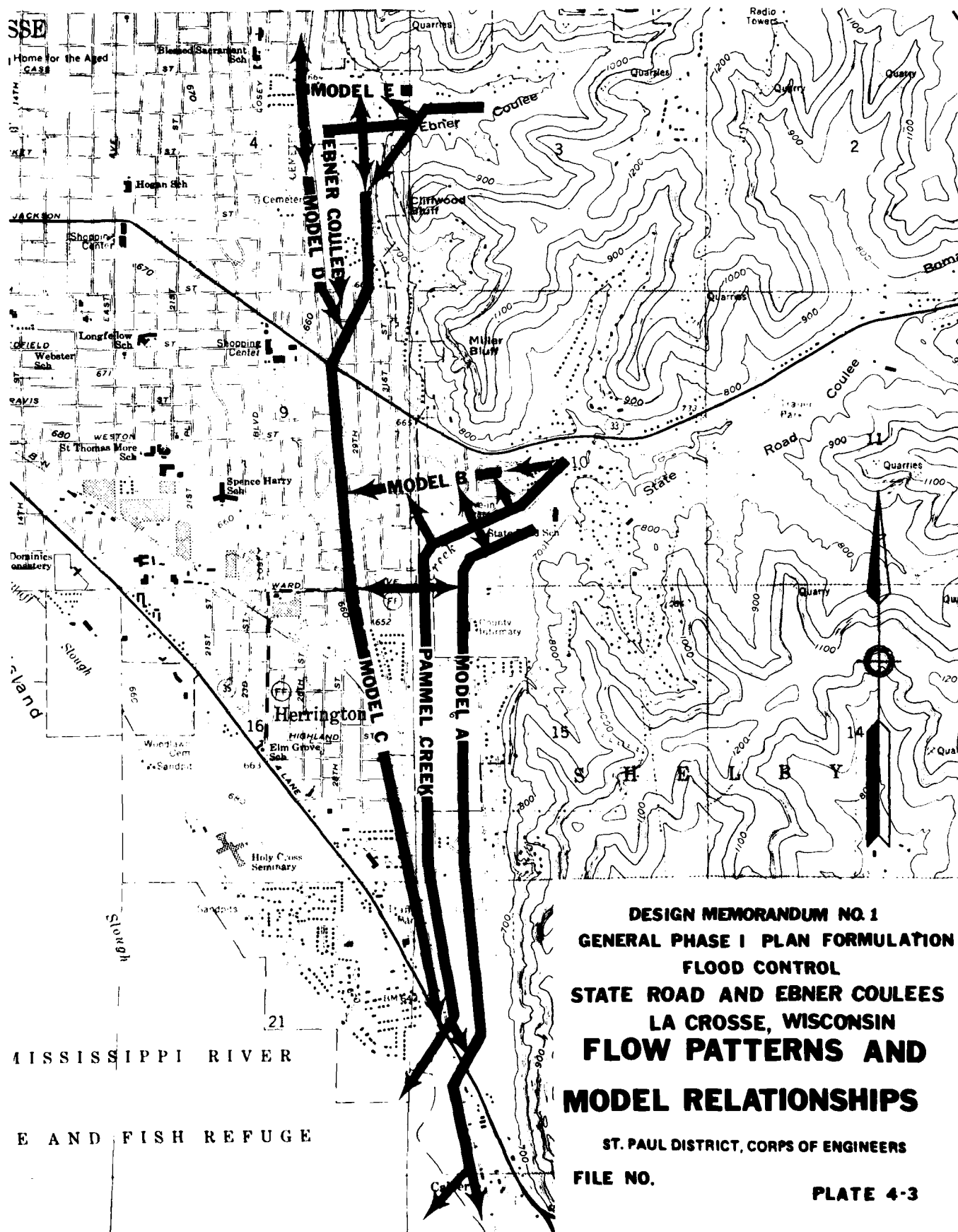
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RECOMMENDED CHANNEL MODIFICATION -  
TYPICAL CROSS SECTIONS - STATE ROAD COULEE

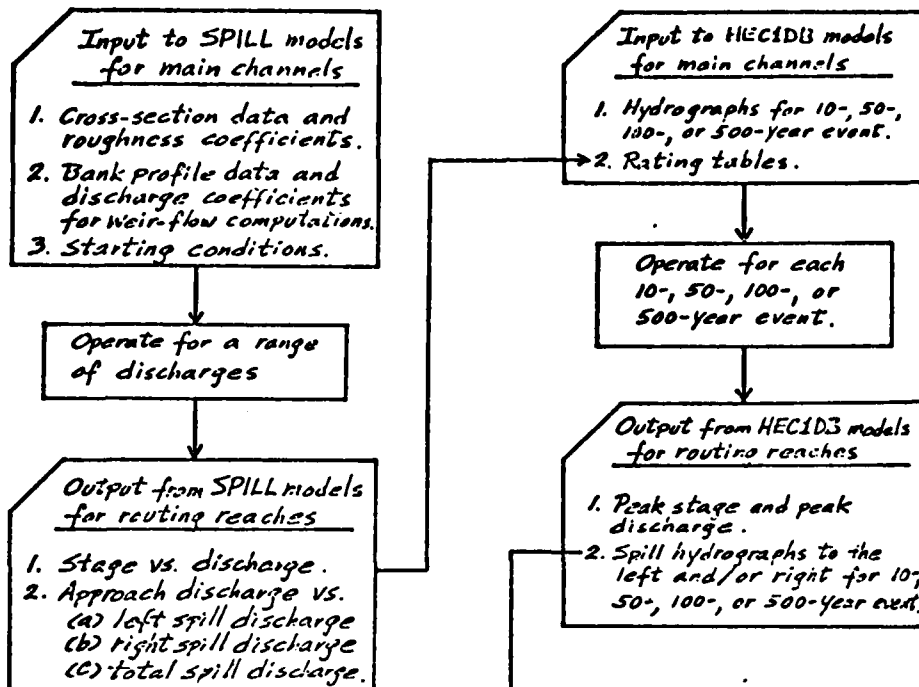
PLATE 4-1

RECOMMENDED CHANNEL MODIFICATION -  
EXISTING CONDITIONS WATER SURFACE PROFILES  
FOR STATE ROAD COULEE  
(TO BE COMPLETED FOR FINAL REPORT)

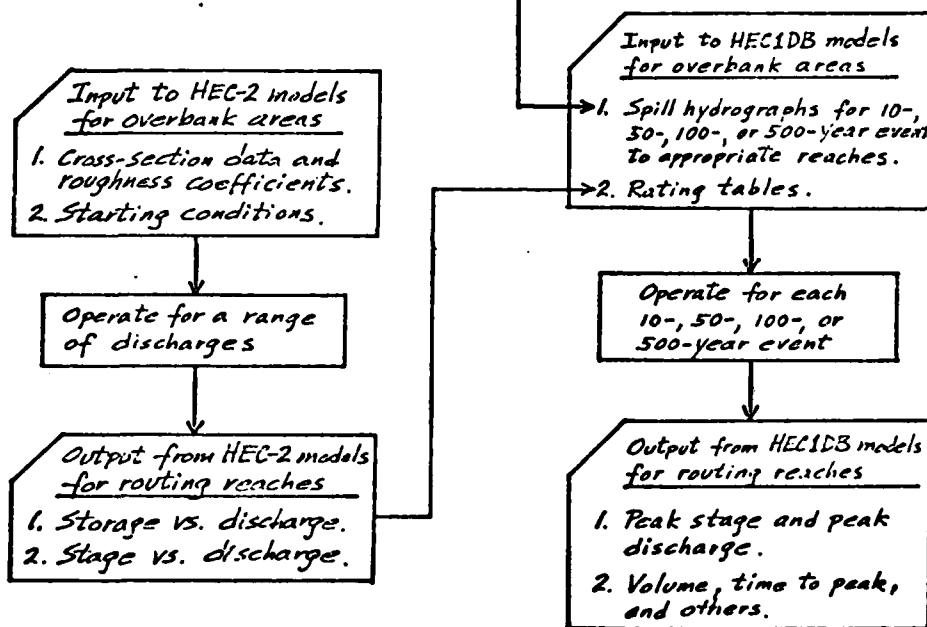
PLATE 4-2



Main Channel System



Overbank System



DESIGN MEMORANDUM NO. 1

GENERAL PHASE 1

PLAN FORMULATION

STATE ROAD AND EBNER COULEES, LA CROSSE, WISCONSIN

OPERATION SCHEME OF HYDRAULICS AND HYDRAULIC MODELS

ST. PAUL DISTRICT CORPS OF ENGINEERS

SUBMITTED:

RECOMMENDED:

APPROVED:

DRAWN BY: MYH FILE NO.

CHECKED BY: SVD

CHIEF, ENGINEERING DIV.

COL. CORPS OF ENGINEERS

TRANSMITTED WITH REPORT

DATED:

RECOMMENDED CHANNEL MODIFICATION  
EXISTING CONDITIONS WATER SURFACE PROFILE FOR  
STATE ROAD COULEE

(To Be Completed For Plate 5 -)

PLATE 4-5



RECOMMENDED CHANNEL MODIFICATION -  
EXISTING CONDITIONS WATER SURFACE PROFILE  
FOR STATE ROAD COULEE

(TO BE COMPLETED FOR FINAL REPORT)





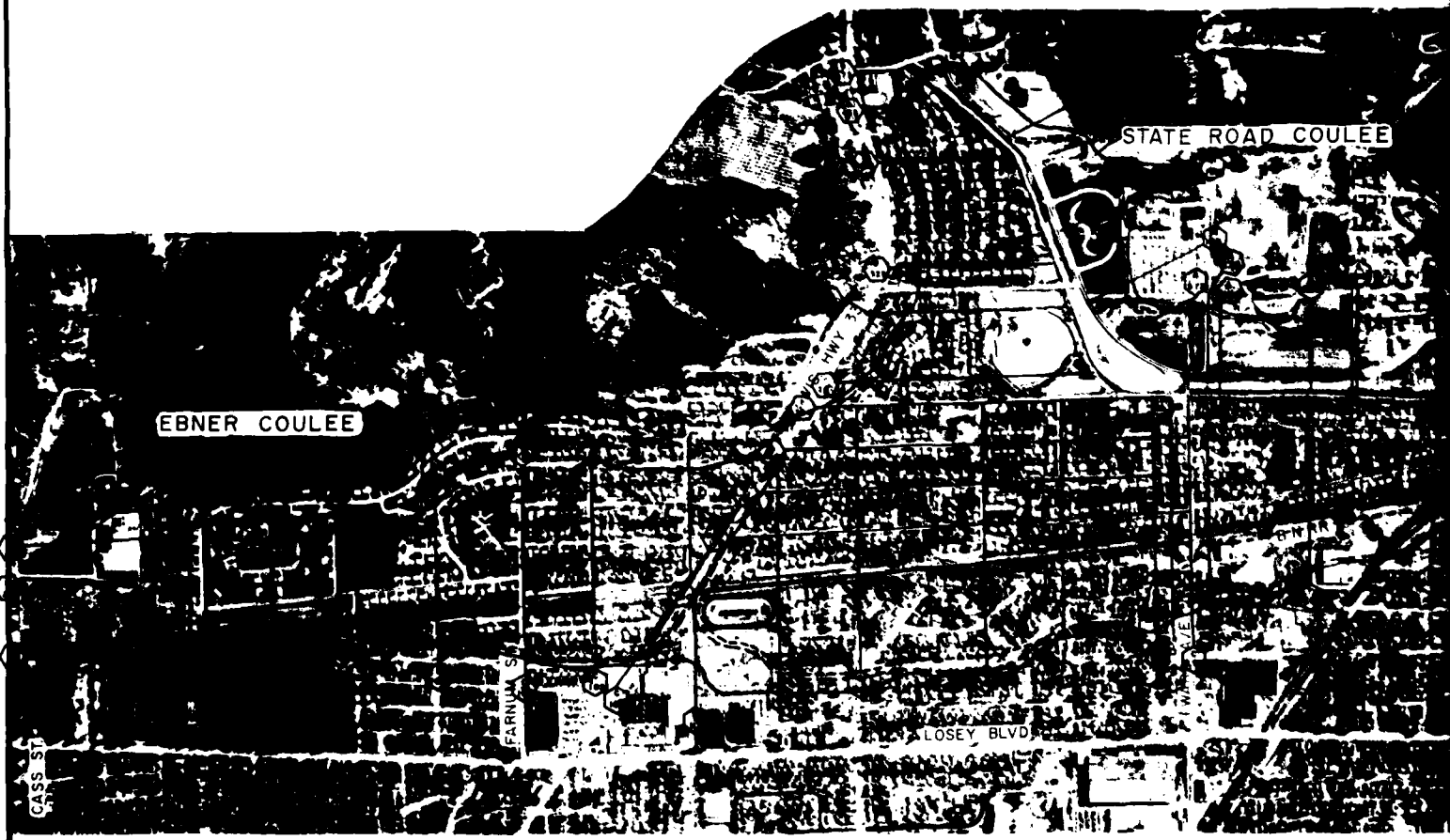
- ..... 100 YEAR OUTLINE  
 ——— SPF OUTLINE

DESIGN MEMORANDUM NO.  
 GENERAL PHASE I PLAN FORMULATION  
 FLOOD CONTROL  
 STATE ROAD AND EBNER COULEES  
 LA CROSSE, WISCONSIN

**MISSISSIPPI RIVER FLOODPLAIN**

ST. LOUIS, MISSOURI DISTRICT

PLATE 4-7



- 100 YR FLOODPLAIN
- 500 YR FLOODPLAIN
- STANDARD PROJECT
- ZONE SEPARATION LINE



SCALE IN FEET



FLOODPLAIN  
 FLOODPLAIN  
 PROJECT  
 SEPARATION LINE

STATE ROAD AND EBMER COULEES  
 LA CROSSE, WISCONSIN  
 FLOOD INSURANCE STUDY  
 CROSS SECTION LOCATIONS

ST. PAUL MAN. DISTRICT

1:10,000

PLATE 4-8

ECONOMIC BASE, FLOOD DAMAGE AND BENEFIT ANALYSIS

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5

PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

# ECONOMIC BASE, FLOOD DAMAGE AND BENEFIT ANALYSIS

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## APPENDIX 5

### ECONOMIC BASE, FLOOD DAMAGE AND BENEFIT ANALYSIS

#### INTRODUCTION

An understanding of the economic base and developmental trends is necessary to understand the present and projected flood damage problems and needs at State Road and Ebner Coulees. This economic base study outlines historic and projected economic development, population, employment, and per capita income trends and land use.

This appendix also discusses the procedural analysis used to determine monetary flood damages and benefits at State Road and Ebner Coulees, both with and without proposed flood control improvements, and under present and future conditions, including allowances for future economic growth. The analysis is based on an assumed economic life of 100 years and a Federal discount rate of 7 3/8 percent at price levels prevailing in October 1980.

#### LOCATION AND DESCRIPTION

State Road and Ebner Coulees drain contiguous watersheds of 6 square miles and 1 square mile, respectively, on the east side of the city of La Crosse in west-central Wisconsin. Most of these drainage areas lie in Shelby Township, with the remainder located within the city limits of La Crosse. Both coulees originate in the high bluffs overlooking the Mississippi River and drain westward onto a sand and gravel plain before discharging into the Mississippi River. State Road Coulee rises approximately 3 miles east of the crossing of the main line of the Burlington Northern railroad and State Highway 33. It flows westward for about 3 miles, then south for about 2 miles where it passes under the railroad tracks and U.S. Highways 14 and 61 and discharges into the Mississippi River above lock and dam 8. The downstream reach of this stream is known locally as Pammel Creek, but is referred to throughout this report as State Road Coulee. Ebner Coulee rises in the bluffs approximately 1.5 miles east of the Burlington Northern railroad station in La Crosse. It flows west to the railroad tracks where an artificial channel carries it south along the east side of the tracks into a 48-inch diameter storm sewer at Farnam Street. State Road Coulee has four defined major tributary coulees, all in the upper portion of the basin; Ebner Coulee has no defined major tributaries.

Rugged terrain characterizes the upper portions of both of the basins. Rocky and steep-sloped bluffs rim both coulees. In contrast, the lower reaches of the basins are part of a terrace with a gently sloping terrain. Elevations within the State Road Coulee watershed vary from about 1,260 feet in the upstream reaches to approximately 631 feet at the Mississippi River at the mouth of the coulee. Extreme elevations for the Ebner Coulee watershed range from approximately 1,260 feet in the uplands to 655 feet at the inlet to the storm sewer.

## ECONOMIC BASE

### ECONOMIC DEVELOPMENT

La Crosse was established as a trading center for southwestern Wisconsin and nearby portions of Minnesota and Iowa. Wholesale and retail trade activities have, over the years, grown along with the region. The coming of the railroads complemented previously established water transportation and La Crosse grew in importance as a lumber center as well as a trade center. Manufacturing facilities were slowly attracted to the area and eventually replaced the lumber industry in importance as timber resources became more and more scarce. Most of the industrial and commercial activity in the study area is located in La Crosse.

Existing land use in the La Crosse area is generally constricted between the high bluffs and the frequently flooded lowlands. Urban growth has used almost all contiguous land, including State Road and Ebner Coulees.

The La Crosse area is served by two commercial airlines, three railroads, and five major highways. Passenger train service is available on the Milwaukee Road line under contract with Amtrak. Interstate bus service is provided by Greyhound Bus Lines. Commercial navigation facilities in the La Crosse area include the 9-foot channel on the Mississippi River and a 9-foot spur channel 1.4 miles up the Black River.

## POPULATION

If population is expected to increase in an urban area subject to a flood hazard, potential and actual flood damages may also be expected to increase. The population projection method for small areas used in this report relies on historical trends based on the BEA (Bureau of Economic Analysis) area projected by use of a regression equation by decade to the year 2030. The 1972 OBERS Series C population projection for BEA Region Number 089, La Crosse, was used in the report. Series C projections were considered to be appropriate when compared with recent population estimates of the region. La Crosse is the regional center for the OBERS BLA area as well as the SMSA (Standard Metropolitan Statistical Area), and the prospects for continued economic growth in the area are considered to be excellent.

The population of La Crosse County is 90,094 (1980), representing an average density of 199 persons per square mile, compared with 88 persons per square mile for the State of Wisconsin. La Crosse, with a population of 48,193, serves as the urban center of the seven-county BEA area 089 in western Wisconsin. The trends that were projected show the population of the city of La Crosse decreasing by 6 percent from 1970 to 1980 with Shelby Township increasing by approximately 21 percent. In the same period, La Crosse County shows a 12-percent increase, the economic area will have an 8-percent increase, and the total Wisconsin population will increase by 9 percent.

Since the populations of La Crosse County and Shelby Township have increased faster than OBERS Series C projections over the past 10 years, future populations are projected to increase at the OBERS C rate. Thus, OBERS projections show the county and township population increasing 71 percent by the year 2030. The population of La Crosse will increase only 19 percent by 2030. (The city's population will increase at a lesser rate than the OBERS projection because of restricted land area.)

Despite the decrease in the population of La Crosse over the last 10 years, the city's population is projected to increase in the future because of the increasing populations in nearby townships and counties. The numbers of housing units in La Crosse also increased over the last 10 years, from 16,573 in 1970 to 18,720 units in 1980 (a 13-percent increase). Development of some of the remaining open areas and filling up of existing housing units should increase future population even though the city is restricted in land area.

The following table gives population figures and projections from 1950 to 2030.

Historical and projected populations (1950-2030) and population indexes (1980-2030)

Area	Population									
	1950 (1)	1960 (1)	1970 (1)	1980 (1)	1985 (base year)	1990 (2)	2000 (2)	2010 (2)	2020 (2)	2030 (2)
La Crosse	47,535	47,600	51,300	48,193	49,000	51,000	52,500	54,000	56,000	57,500
Shelby	3,436	5,458	4,600	5,561	5,840	6,100	6,800	7,600	8,600	9,500
La Crosse County (3)	67,587	72,465	80,468	90,094	94,600	99,100	109,900	123,400	138,700	154,100
BEA 089 (4)	225,063	255,185	270,451	292,900	308,050	323,200	357,900	401,100	450,800	500,500
Wisconsin	3,435,000	3,952,000	4,418,000	4,820,000	5,098,000	5,384,000	5,843,000	6,400,000	7,000,000	7,600,000
United States (3)	151,871,000	179,323,000	203,858,000	234,208,000	251,984,000	269,759,000	306,782,000	350,111,000	399,013,000	

Index				
1980	1985	1990	2000	2030
La Crosse	100	106	109	112
Shelby	100	105	110	112
La Crosse County	100	105	110	112
BEA 089	100	106	112	115
Wisconsin	100	108	115	122
United States	100	108	115	122

(1) Bureau of the Census data.

(2) Extrapolated past 1978 Bureau of Census estimates for La Crosse, Shelby, and La Crosse County by least squares regression.

(3) OBERS Series C projections.

(4) Wisconsin population projections to the year 2000 - Wisconsin Department of Administration, June 1975.

## EMPLOYMENT

In 1970, 19,623 persons were employed in La Crosse, representing about two-thirds of the 30,005 persons employed in La Crosse County. Total employment in the city declined somewhat in 1960, but increased in 1970 to about the 1950 employment level. Between 1950 and 1970, significant employment gains occurred in wholesale and retail trade, services and government. Declines in employment occurred in construction, manufacturing, transportation and communication, finance, insurance and real estate as shown in the following table.

Industry	La Crosse employment					
	1950	Percent of total	1960	Percent of total	1970	Percent of total
Agriculture, forestry and fisheries	110	0.6	176	1.0	116	0.6
Mining	9	0.1	0	0	15	0.1
Construction	837	4.3	722	4.1	772	3.9
Manufacturing	7,038	35.8	5,379	30.3	4,956	25.2
Transportation and communications	1,853	9.4	1,284	7.2	1,389	7.1
Wholesale and retail trade	4,596	23.4	4,120	23.2	4,865	24.8
Finance, insurance and real estate	373	1.9	466	2.7	289	1.5
Services	3,948	20.1	4,578	25.8	6,529	33.3
Government	572	2.9	590	3.3	692	3.5
Industry not reported	297	1.5	423	2.4	-	-
<b>Total</b>	<b>19,633</b>	<b>100.0</b>	<b>17,738</b>	<b>100.0</b>	<b>19,623</b>	<b>100.0</b>

SOURCE: U.S. Bureau of the Census, General Social and Economic Characteristics, 1950, 1960, 1970.

Employment in La Crosse County increased by 3,024 persons between 1950 and 1970, indicating an increase in employment in the several townships of the county. Agricultural and manufacturing employment declined significantly during this period. The largest gain in employment occurred in services, followed by wholesale and retail trade, government and contract construction. The following table shows this employment trend.

La Crosse County employment						
Industry	1950	Percent of total	1960	Percent of total	1970	Percent of total
Agriculture, forestry and fisheries	2,560	9.5	1,892	9.2	1,121	3.7
Mining	19	0.1	4	0.1	32	0.1
Contract construction	1,244	4.6	1,206	4.6	1,500	5.0
Manufacturing	8,884	32.9	7,565	29.0	7,769	25.9
Transportation and communication	2,307	8.6	1,806	6.9	2,167	7.2
Wholesale and retail trade	5,645	20.9	5,598	21.5	6,939	23.1
Finance, insurance, and real estate	454	1.7	627	2.4	459	1.5
Services	4,717	17.5	5,929	22.7	8,990	30.0
Government	743	2.7	859	3.3	1,028	3.5
Industry not reported	408	1.5	600	2.3	-	-
Total	26,981	100.0	26,086	100.0	30,005	100.0
Unemployment rate	6.8		7.2		7.4	

SOURCE: U.S. Bureau of the Census, General Social and Economic Characteristics 1950, 1960, 1970.

The unemployment rate exceeded 6 percent for 13 years during the period 1950-1970. During the last 10 years, the unemployment rate has averaged below 6 percent. The April 1980 unemployment rate was 5 percent. Total employment in BEA economic area 089 is expected to increase from 100,580 persons in 1970 to 183,800 persons in 2020, an increase of 83 percent. Employment in the United States is expected to increase 106 percent during this period. The projected participation rate for the economic area is approximately the same as for the United States. The following table shows the employment projections for BEA economic area 089.



Employment projections, La Crosse BEA economic area and the United States (1)

Item	Year				
	1970	1980	1990	2000	2010
Employment, La Crosse					
BEA economic area	100,580	115,900	127,200	144,200	163,100
Employment United States	79,306,527	93,820,000	106,917,000	124,641,000	143,441,000
Participation rate BEA					
economic area 089(2)	0.37	0.40	0.39	0.40	0.41
Participation rate United					
States	0.39	0.40	0.40	0.41	0.41

(1) 1972 OBERS projections, series C, U.S. Water Resources Council, Washington, D.C.

(2) Participation rate = employment/population.

## INCOME

One measure of the economic well-being of a community is its magnitude of income. Personal income is income received from all sources and is measured before deduction of income taxes and other direct personal taxes. Per capita income of a community is personal income divided by population and is one measure of the average standard of living in the community.

Per capita income for La Crosse County and La Crosse in 1977 was \$5,305 and \$5,416 (1977 dollars), respectively. In comparison, the per capita income for the State of Wisconsin was \$5,660. Both La Crosse and La Crosse County had average incomes in 1977 about 5 percent below the State average.

Per capita income in 1970 in BEA economic area 089 was \$2,713 (1967 dollars) and is projected to grow to \$12,304 by the year 2020, an increase of 353 percent. The per capita income in 1970 for the United States was greater than for the BEA area and projections indicate the relationship will continue through the year 2020. The projections of per capita income for the La Crosse BEA area and the United States are compared on the following table.

Area	Per capita income projections (1967 dollars) <sup>(1)</sup>							
	Year							
	1970	1980	1985	1990	2000	2010	2020	2030
BEA 089	2,713	3,945	4,593	5,240	7,086	9,385	12,304	15,223 <sup>(2)</sup>
Index	-	100	116	132	180	238	312	386
United States	3,476	4,765	5,466	6,166	8,289	10,895	14,260	-
Index	-	100	115	129	174	229	299	-

(1) 1972 OBERS, series C.

(2) Extrapolated.

## EDUCATION

Data from the 1970 U.S. Census of Population for Wisconsin indicate persons over 25 years of age in La Crosse completed a median of 12.3 years of school. About 40 percent of the females and 35 percent of the males completed 4 years of high school. Approximately 8 percent of the males and 7 percent of the females completed 4 years of college. The average for the State of Wisconsin for persons 25 years and older was about 35 percent completing high school and about 6 percent completing 4 years of college. Thus, the educational levels for the city of La Crosse slightly exceed the average levels for the State of Wisconsin.

## FLOOD DAMAGES

### GENERAL

Urban properties in eastern La Crosse and western Shelby Township are susceptible to flood damages from State Road and Ebner Coulees. In this economic analysis, annual flood damages have been computed for the 1980 present conditions and the 1985 base year conditions. The 1985 base year is the year when the proposed flood control improvements would be completed and in operation. This economic analysis also recognizes the future damage potential of existing floodplain development under future projected conditions and the extent to which various alternatives will reduce damages over an assumed period of 100-year economic life. The 100-year, 500-year, and standard project flood outlines for State Road and Ebner Coulees are shown on plate 5-1. These flood outlines were determined in a 1979-80 flood insurance study (see appendix 6). These flood outlines were adopted by the Federal Emergency Management Agency for the area flood insurance studies and by the St. Paul District for this phase I project evaluation.

## CHARACTERISTICS OF THE FLOOD DAMAGES

All of the flood damages in the area are classified urban and include residential, commercial, and public damages.

Residences can be flooded in two ways - directly and indirectly. Both cause damage to the dwelling, contents, and other personal property. Direct flooding occurs when water flows directly into the home. Indirect damages occur when water travels into the home by means such as seepage and sanitary sewer backup.

Indirect damages are not included in this analysis because in both the State Road and Ebner Coulee floodplains even the intense flows are of short duration and the soil is such that it would not quickly absorb the water. Thus, there would be little problem with basement seepage in the area. Also, the State Road and Ebner Coulee areas have modern sanitary sewer systems. This sewer system functions well and prevents sewer backup unless the sanitary lift stations become inoperable. Historically there has been only a negligible amount of indirect flooding damage in the area.

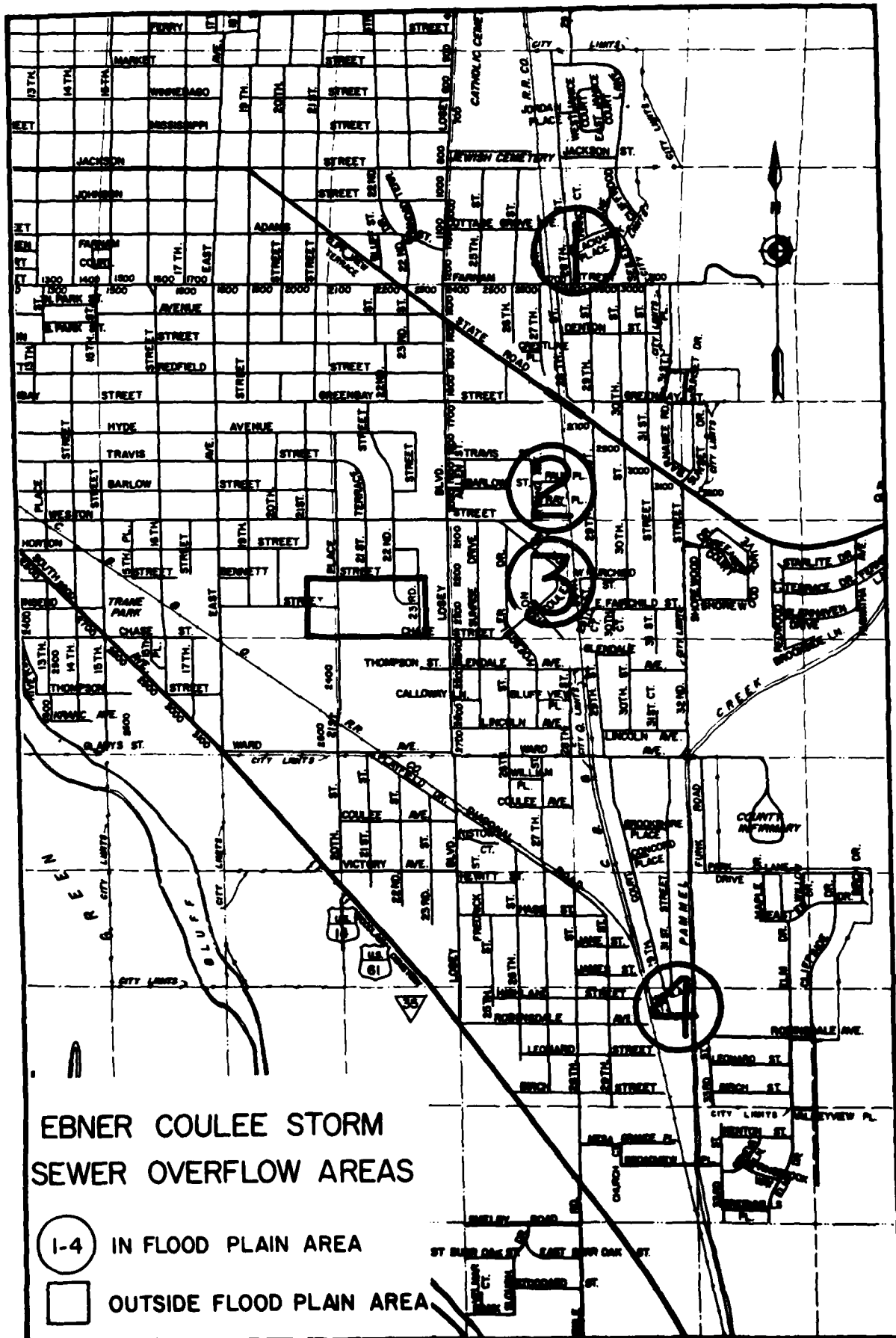
Losses to commercial establishments include physical damages to buildings, equipment, and stocks of merchandise and losses caused by interruption of business, including wages not earned by employees and profits not earned by the firm.

Losses to public properties include physical damages to streets, sidewalks, parks, schools and other public buildings, sewers, and sewage treatment facilities. Other public losses include additional costs incurred by local and State governments for emergency relief activities and overtime work by the police, firemen, and other public employees.

Direct flooding caused by storm sewer overflow occurs within the floodplain of Ebner Coulee. The principal locations are:

1. Twenty-eighth Street and Blackhawk Place.
2. Paul Place and 27th Street.
3. Coulee Drive.
4. Highland and 31st Street.

These locations are shown on the following figure.



Flooding caused by storm sewer backup occurs in an area outside of the floodplain. This area is bounded by Bennett Street, 23d Street, Chase Street, and 21st Street. Damages to several homes and to the Trane Company Plant No. 7 can occur during high flows of Ebner Coulee. This area is also shown on the previous figure.

When the storm sewer which begins under Farnum Street, has reached capacity from Ebner Coulee flows, water begins to back up in the branch storm sewer lines downstream. The hydraulic head in the line causes pressure which then forces the stormwater up against gravity into the branch sewers. The branch near 23d Street and Chase then overflows and floods the area.

#### FLOOD DAMAGE SURVEYS

Information on flood damages was first obtained by a field survey in April 1961. The data for this report were obtained by field surveys conducted in January 1975 and April 1980. Estimates of flood damages likely to be caused to commercial and public properties by inundation to various depths were obtained in interviews with businessmen and public officials. Residential damages were estimated by determining the approximate market value of each floodplain residence, the elevation of the ground, and the elevation of the first floor. Damages were then computed using the standard depth-damage tables of the St. Paul District, Corps of Engineers.

The results of the 1975-1980 damage surveys are shown in the following table. About 94 percent of the potential flood damages are residential and about 5 percent are commercial. Less than 1 percent are public damages.

1980 flood damage survey, State Road and Ebner Coulees

Coulee	10-year flood				100-year flood				Standard project flood			
	Commercial and industrial		Public		Commercial and industrial		Public		Commercial and industrial		Public	
	Residential	Total	Residential	Total	Residential	Total	Residential	Total	Residential	Total	Residential	Total
Ebner	2,309,600	403,200	6,600	2,719,400	5,843,900	459,600	7,200	6,310,700	9,877,800	645,600	8,000	10,531,400
Discharge				900 cfs				1,500 cfs				2,000 cfs
State Road	5,539,300	234,600	30,200	5,804,100	7,715,500	300,900	37,600	8,054,100	10,320,100	469,400	51,700	10,841,200
Discharge				2,850 cfs				5,400 cfs				7,500 cfs
Total	7,848,900	637,800	36,800	8,523,500	13,559,400	760,500	44,800	14,364,800	20,197,900	1,115,000	59,700	21,372,600
Percent of total	92.1	7.5	0.4	100.0	94.4	5.3	0.3	100.0	94.5	5.2	0.3	100.0

Flood damages on State Road Coulee begin at 1,100 cfs. State Road Coulee has an existing channel capacity of 1,100 cfs upstream of Ward Avenue and 1,800 cfs downstream of Ward Avenue, with one exception. The channel capacity where State Road Coulee goes under the Burlington Northern railroad bridge is about 1,300 cfs. Ebner Coulee's existing capacity is approximately 400 cfs along the reaches running westward and about 130 cfs along the portion running southward. Damages first occur at 130 cfs and increase at a greater rate when additional overflows occur at 400 cfs.

#### HYDROLOGY AND HYDRAULICS OF THE FLOOD DAMAGES

The 1975 and 1980 field surveys determined elevations and values for all structures in the floodplain. Structural elevations were related to the water surface profiles and frequencies shown on tables 4-1 through 4-6 in appendix 4 (adjusted to 1912 msl), which were developed for the flood insurance study. These water surface profiles were used to develop the damage for each flow frequency. These flow frequencies and damages along with the zero point for damages were used to plot the frequency-damage curves and to compute the average annual damages shown on plates 5-3 and 5-4. As shown by the plates in appendix 4, there are multiple flow channels throughout the project area. Each structure had its damages determined from the flood flow channel in which it was located.

A look at historical flooding shows apparent discrepancies between the damages and the hydraulic information on State Road and Ebner Coulees. Several factors cause this to happen.

First, there is a large drop in elevation from the upstream bluffs of the two coulees to their confluences with the Mississippi River. Residences are located at various elevations up and down the coulee. Thus the two hydrologic gages will not give a reading at the elevations of most of the homes.



Also, since even large amounts of stormwater drain rapidly from the two small basins, it is important that the proper time units be used for the hydrographs. During a single storm event, a hydrograph with time units longer than the short drainage time will not take into account the fact that early flows will drain completely off of the coulee while the storm is still occurring.

Third, damages occur when floodwater spills out of both sides of State Road and Ebner Coulees. For most flood flows, this water will spill out at the same points. These points are located near 29th Street on Ebner Coulee and upstream from Ward Avenue on State Road Coulee. Floodwater can flow from these points and never return to the channel. Thus, this water will produce a complex set of individual flows and flood depths throughout the floodplain.

The combination of hydraulic factors makes it difficult to correlate flood depths and discharges with flood damages. However, observed 1976 damages are shown in the following table along with projected damages for a recurrence of the 1959 flood with current development.

Year	Damages from historical floods <sup>(1)</sup>		
	Depth (feet) <sup>(2)</sup>	Discharge (cfs) <sup>(3)</sup>	Damages
1959	7.6	5,000	\$6,814,000
1978	5.0	3,000	404,000

- (1) Damages reflect development at the date shown and 1980 prices.  
 (2) Maximum depth of residential flooding.  
 (3) Discharge at Hagen Road bridge.

## LAND USE

### EXISTING LAND USE

As an urban area such as La Crosse develops, floodplain lands formerly used for agricultural production or which had remained vacant become attractive for economic development. Floodplains are normally easier to develop than are hillsides and the existence of nearby services and transportation in La Crosse may give the floodplain a locational advantage over alternative development sites not located in the floodplain areas. This locational advantage may lead to the development of flood prone areas in spite of the potential flood hazard.

The rugged terrain bordering the entire east side of La Crosse has restricted most residential development to the lower terrace areas at the base of the bluffs. As a result, the lower portions of both the State Road and Ebner Coulee watersheds contain moderately dense and relatively high-valued residential developments. Many of these developments are located within the city limits of La Crosse with the remainder along the coulees in western Shelby Township. A few commercial establishments are also located within the lower areas of the watershed.

Since 1968, 140 acres of agricultural land in State Road Coulee and 23 acres in Ebner Coulee have been converted to urban use. Considerable residential development has occurred recently on the floodplains of the two coulees and on the upland wooded areas. The number of residences in the standard project floodplain increased from 725 in 1967 to 1,503 in 1980, an increase of 778.

Since State Road and Ebner Coulees are located in both the city of La Crosse and Shelby Township, 1976 land use data for these latter areas are shown in the table below. Also, existing land use information for State Road and Ebner Coulee watersheds and 100-year floodplains on the lower coulees is shown in the following tables.

1976 land use, city of La Crosse and town of Shelby						
Category	City of La Crosse (acres)	Percent of total area	Percent of urbanized area	Town of Shelby (acres)	Percent of total area	Percent of urbanized area
Wholesale and retail	315	3.3	4.5	44	0.2	2.1
Commercial	175	1.8	2.5	28	0.1	1.3
Manufacturing	261	2.7	3.8	11	0.1	0.5
Transportation and utilities	2,444	25.6	35.3	529	2.7	24.8
Residential	2,360	24.8	34.1	591	3.0	27.7
Public and semipublic	343	3.6	5.0	52	0.3	2.4
Parks and recreation	<u>1,026</u>	<u>10.8</u>	<u>14.8</u>	<u>876</u>	<u>4.4</u>	<u>41.2</u>
Total urbanized	6,924	72.6	100.0	2,131	10.8	100.0
Agriculture	0	0		13,128	66.7	
Extractive mining	0	0		33	0.2	
Vacant land	1,255	13.2		1,860	9.5	
Marshland	344	3.6		779	4.0	
Open water	<u>1,009</u>	<u>10.6</u>		<u>1,739</u>	<u>8.8</u>	
Total unurbanized	2,608	27.4		17,539	89.2	
Total land area	9,532	100.0		19,670	100.0	

SOURCE: La Crosse City Planning Department

Existing land use, State Road and Ebner Coulee watersheds								
Area	Total acres	Cropland (acres)	Percent total	Pasture (acres)	Percent total	Wooded (acres)	Percent total	Urban (acres)
State Road watershed	4,797	540	11	230	5	2,494	52	1,533
Ebner Coulee watershed	618	34	6	7	1	392	63	185
shed								

SOURCE: Soil Conservation Service

Existing land use, 100-year floodplain, State Road and Ebner Coulees			
Coulee	Category	Acres	Percent of total area
State Road	Residential:		
	Single family	211	50
	Multiple family	21	5
	Commercial	57	13
	Vacant	33	8
	Channelized stream	40	9
	Railroad	7	2
	Streets	48	11
	Park	8	2
	Total	425	100
Ebner	Residential:		
	Single family	127	63
	Commercial	13	6
	Vacant	6	2
	Railroad	25	12
	Highway and streets	22	11
	Coulee	2	1
	Public	10	5
	Total	205	100

Shelby Township, containing 19,670 acres, is almost twice the size of the city of La Crosse with 9,532 acres. Agricultural use represents about two-thirds of the land area in Shelby Township; residential use represents only about 3 percent of the total land area. The two largest categories of land use in the city of La Crosse are residential and transportation and utilities.

About 4,797 acres and 618 acres are located in the State Road and Ebner Coulee watersheds, respectively; 32 percent of State Road Coulee and 30 percent of Ebner Coulee are urbanized. Over 50 percent of each watershed is wooded, with the remaining acreage in cropland and pasture.

Residential use in the 100-year floodplain of State Road Coulee represents about 50 percent of the total land area. About 8 percent of the area is vacant. Commercial use accounts for about 13 percent and streets represent 11 percent of the area. About 425 acres are located in the 100-year floodplain of State Road Coulee.

In the 100-year floodplain of Ebner Coulee, residential use represents 64 percent of the total area followed by railroads, highways and streets, commercial, and vacant uses. About 205 acres are in the 100-year floodplain of Ebner Coulee.

Land use under existing conditions is shown on plate 5-2.

#### FUTURE LAND USE

The major problem in planning the land use pattern of the La Crosse area is the severe shortage of land for urban expansion. Outward growth of La Crosse is limited in many directions by topography and drainage, with the Mississippi River and its flood prone islands to the west, the marshlands of the La Crosse River to the northeast, and steep bluffs in the east. Economic activities in La Crosse should continue to expand, requiring an increase in urban land. Land use plans for La Crosse showed existing vacant land in the southeast and east of La Crosse, including State Road and Ebner Coulees, and vacant land to the north of the city as areas to be developed for housing. The town of Shelby, located east and south of the city of La Crosse, is a logical site for urban expansion. However, potential residential land in the town of Shelby is very limited because of rugged topography and unsuitable soils. Little manufacturing land use is expected in the town of Shelby and no large commercial areas are planned since the town is served by shopping centers in La Crosse.

The Wisconsin Department of Natural Resources regulates the area's floodplains. All future development must conform to these regulations. La Crosse will soon adopt these regulations into its land use plans. Their regulations include the zoning of special flood storage districts where new development is restricted.

Public Law 93-234, the Flood Disaster Protection Act of 1973, requires adoption and enforcement of land use regulations as a condition of future Federal financial assistance. Since 1 March 1974, mortgage loans from all federally insured lending institutions are required, prior to approval,

to have Federal flood insurance if the property lies within the 100-year flood zone. Thus, at present, new development in the floodplain is limited to flood proofed structures. However, the limits of the 100-year floodplain are expected to be reduced after construction of the channel improvement project. Construction would then be allowed above the adjusted 100-year floodplain. Because of the floodplain regulation provision of Public Law 93-234, development with and without the project is assumed to be different. The numbers of structures expected to receive direct damages from a 100-year flood without a flood control project, under present and future conditions, are shown on the following table.

Numbers of structures expected to receive direct damages without the project for present and estimated future development, 100-year floodplain, State Road and Ebner Coulees

Coulee	Property type	Year							
		Existing 1975	1980	1990	2000	2010	2020	2030	2080
State Road	Residential units	397	397	397	397	397	397	397	397
	Commercial	3	3	3	3	3	3	3	3
	Public	4	4	4	4	4	4	4	4
Ebner	Residential units	370	370	370	370	370	370	370	370
	Commercial	2	2	2	2	2	2	2	2
	Public	2	2	2	2	2	2	2	2

About 189 additional residential units not sustaining direct damage are located in the 100-year floodplain of State Road Coulee. In addition, 256 apartment units, 72 townhouse units, and 21 mobile homes could receive minor damage from a 100-year flood, but are not included in the above table. On Ebner Coulee, about 116 additional residential units not sustaining direct damages are located in the 100-year floodplain. Residences not sustaining direct damages but located within the 100-year floodplain normally would receive indirect damages through basement seepage. However, in La Crosse, the flood durations are short enough to prevent these indirect damages.

Floodplain development patterns with the project would be different from those without the project. However, these differences would not be great since there is a limited amount of vacant land. The Ebner Coulee reach has 6 acres of vacant land. This area is projected to be developed with flood proofed homes without the project; the homes would not be flood proofed with the project.

State Road Coulee contains 33 acres of vacant land. Thirteen acres are projected to be developed with or without the project. This area will be filled with flood proofed homes without the project or nonflood proofed homes with the project. Eight acres are in a Department of Natural Resources regulated special flood storage district. This area would be developed only with a project in place. The remainder of the vacant land will probably be changed to a park regardless of project status.

There is also a possibility of changes in the developed areas. Some of the commercial areas may be developed into residential use if a project is in place. This, however, is not projected.

The projections of changes in the development of the vacant areas are shown in the land use plate 5-2 and in the following table.

Future development of vacant land			
Future plans of each vacant area	State Road Coulee	Ebner Coulee	Claimable benefits
Homes flood proofed without project and not flood proofed with project	13	6	Flood proofing
Area developed with project in place (acres)	8	0	Location
Area that will change to parkland with or without the project (acres)	12	0	None



## FUTURE FLOOD DAMAGE METHODOLOGY

### GENERAL

The value of existing residential structures and contents in the standard project floodplain is shown in the next table. About 530 single family residential structures expected to receive direct damages are located in the standard project floodplain of State Road Coulee and about 565 in Ebner Coulee.

The average value per structure in both the 100-year and the standard project floodplain of State Road and Ebner Coulees is about \$32,000. The structural value equals the total market value of the residence minus the land value. The average value of the contents is about \$8,000, based on an estimated content value of 25 percent of the value of the structure.

Value of residential development in the standard project floodplain of  
State Road and Ebner Coulees

Coulee	Structures receiving direct damages	Total market value		Average value per structure	Average value of contents	Average value of contents as a percent of average structural value
		Structure	Contents			
State Road	530	\$17,050,000	\$4,253,300	\$32,000	\$8,000	25
Ebner	565	18,137,000	4,534,100	32,000	8,000	25
Total	1,095	35,187,000	8,787,400	32,000	8,000	25

### GROWTH RATE OF THE RESIDENTIAL CONTENT VALUE

The adjusted OBERS regional growth rate for per capita income was used as the basis for increasing the real value of residential contents. As affluence increases, the value of residential contents will also increase. The value of the residential contents was projected as the per capita income growth rate to a maximum level of 75 percent of the value of the residential structure. The projected maximum level in value of residential contents

is expected to occur by the year 2021. After this date, the value of contents was held constant. No new residential structures except flood proofed structures are contemplated in the 100-year floodplain without the project because of zoning requirements of Public Law 93-234 (the Flood Disaster Protection Act of 1973).

La Crosse has good prospects for future growth and development despite the restricted land area. Thus, OBERS Series C was used to project future per capita income. The present per capita income is more in line with the Series C income estimate than any other estimate.

OBERS Series C projects per capita income to grow to \$16,682 by 2035, 50 years after the base year. Present per capita income (1980) is \$3,945. Per capita income is projected to increase by a factor of 4.23 in 55 years ( $\$16,682/\$3,945 = 4.23$ ).

The compound growth rate of per capita income is  $2 \frac{11}{16}$  percent per year. This number is found by obtaining the compound growth rate which most nearly equals 4.23 in 55 years.

The present value of contents is estimated at 25 percent of the structural value. According to regulations, the content value cannot increase past 75 percent of the structural value ( $75 \div 25 = 3$ ). Thus, content value is projected to increase by a factor of 3. After the content value has increased by a factor of 3 (to 75 percent of the structural value) it is assumed to remain constant.

The content value will reach 75 percent of the structural value in 41 years. This value is found by obtaining the number of periods in which 1 increases to 3 at a compound growth rate of  $2 \frac{11}{16}$  percent per year (41 years plus the year 1980 equals the year 2021). The following table shows the growth of content value at a rate of  $2 \frac{11}{16}$  percent per year.

Growth rate for residential contents		
Year	Number of years	Growth index
1980	0	1.000
1985	5	1.142
1995	15	1.489
2005	25	1.941
2015	35	2.530
2021	41	3.000

The projected rate of increase in the value of flood-susceptible household contents was used as the basis for increasing the future unit flood damage to household contents.

#### COMMERCIAL AND INDUSTRIAL DAMAGES

The unit values of commercial and industrial properties were not increased over time using the affluence factor procedure previously described. Since no new future commercial and industrial structures are contemplated without the project, no future growth of damage to these categories was claimed in the report. However, existing commercial and industrial damages will probably increase as content value and inventory value increase. Wages lost to workers during floods and profits lost by businesses would also increase in the future. Because of the lack of empirical evidence on the future development of existing commercial and industrial damages, no future damages in these categories were claimed in the report.

#### PUBLIC DAMAGES

Future public damages are unrelated to changes in income; i.e., more affluence. Growth in public damages is considered to be a function of physical improvements in city plant facilities and public use by a larger population.

## FLOOD DAMAGE ANALYSIS

The hydrologic conditions used in this report are based on urbanized runoff conditions. The "urbanized runoff condition" is a projection of what the discharge rate from a flood would be if the contributing drainage area were completely developed. The contributing drainage area is expected to be completely developed in 1995. The runoff rate with the future urbanized condition is projected to be greater than with existing conditions. This is because land with added homes, streets, driveways, and landscaped yards will absorb less water and consequently will drain water more quickly than undeveloped land, thus increasing the discharge rate for each storm. The use of future hydrologic conditions is required in the Federal Register; Procedures for Evaluation of NED Benefits and Costs in Water Resource Planning 713.521A, 14 December 1979.

Average annual existing residential unit damages for State Road and Ebner Coulees are illustrated on the following table. Average annual structural and content damages for State Road Coulee are estimated to be \$1,862 and \$1,242, respectively. The average annual structural and content damages for Ebner Coulee are \$669 and \$446, respectively.

Average annual residential unit damages, 1980 conditions				
Coulee	Category	Average annual damages	Number of structures	Average annual damages per unit
State Road	Residential:			
	Structure	\$987,000	530	\$1,862
	Contents	658,000	530	1,242
	Total	1,645,000		3,104
Ebner	Residential:			
	Structure	378,000	565	669
	Contents	252,000	565	446
	Total	630,000		1,115

The future increase in content damages is the only increase projected for the residential unit damages. The content damages will increase at the same level as the growth rate of the contents shown in the table on page 5-26. Content damages are estimated to increase 200 percent from 1980 to the year 2021 when they are assumed to remain constant. Structural damages are assumed to remain constant over the life of the project. No new residential structures are expected to be constructed in the 100-year floodplain without the project, except for flood proofed structures. Unit flood damages for future conditions are shown in the following table.

Unit flood damages with adjustment for future increase in content damages		Year							
Coulee	Category	1980	1985	1995	2005	2015	2021	2035	2085
State Road	Residential:								
	Structure	\$1,862	\$1,862	\$1,862	\$1,862	\$1,862	\$1,862	\$1,862	\$1,862
	Contents	<u>1,242</u>	<u>1,418</u>	<u>1,849</u>	<u>2,411</u>	<u>3,142</u>	<u>3,726</u>	<u>3,726</u>	<u>3,726</u>
	Total	3,104	3,280	3,711	4,273	5,004	5,588	5,588	5,588
Ebner	Residential:								
	Structure	796	796	796	796	796	796	796	796
	Contents	<u>531</u>	<u>606</u>	<u>791</u>	<u>1,031</u>	<u>1,343</u>	<u>1,593</u>	<u>1,593</u>	<u>1,593</u>
	Total	1,327	1,402	1,587	1,827	2,139	2,389	2,389	2,389
Index of totals		1.000	1.057	1.200	1.377	1.612	1.800	1.800	1.800
Growth rate of the contents		1.000	1.142	1.489	1.941	2.530	3.000	3.000	3.000

Average annual residential, commercial, and public damages over the life of the project are estimated to be \$2,183,400 for State Road Coulee and \$970,800 for Ebner Coulee. The tables on pages 5-29 and 5-30 indicate these average annual damages.

Present and future average annual damages, State Road Coulee (without project)

Physical flood losses by property type	Existing (1) conditions 1980	Average annual damages					Increase 1985-2035	Average annual equivalent of increase over 100-year project life damages	Total average annual damages
		1985	1995	2005	2015	2023			
Residential	\$1,385,000	\$1,738,300	\$1,966,700	\$2,264,500	\$2,651,900	\$2,961,400	\$1,223,100	\$351,400 (2)	\$2,089,700
Commercial	84,000	84,000	84,000	84,000	84,000	84,000	0	0	84,000
Public	7,700	8,200	9,100	9,900	10,800	11,700	5,200	1,500 (3)	9,700
Total average annual damages	1,476,700	1,830,500	2,059,800	2,358,400	2,746,700	3,057,100	3,058,300	352,900	2,183,400
Index	1	1.054	1.186	1.358	1.582	1.760	1.761	1.761	

(1) The 1980 base year reflects existing hydrologic conditions; other years reflect 1990 urbanized conditions.

(2) Average annual equivalent compound interest factor for 41 years of a 100-year economic life at 7 3/8-percent interest = 0.2874.

(3) Average annual equivalent compound interest factor for 50 years of a 100-year economic life at 7 3/8-percent interest = 0.2823.

Present and future average annual damages, Ebner Coulee (without project)

Physical flood losses by property type	Existing (1) conditions 1980	Average annual damages					Increase 1985-2085	Average annual equivalent of increase over 100-year project life damages	Total average annual damages
		1985	1995	2005	2015	2021			
Residential	\$630,000	\$665,900	\$756,000	\$867,500	\$1,015,600	\$1,134,000	\$1,134,000	\$468,100	\$800,400
Commercial	169,000	169,000	169,000	169,000	169,000	169,000	169,000	0	169,000
Public	1,100	1,200	1,300	1,400	1,500	1,700	1,800	600	1,400
Total average annual damages	800,100	836,100	926,300	1,037,900	1,186,100	1,304,700	1,304,800	468,700	970,800
Index	1	1.045	1.158	1.297	1.482	1.631	1.631	1.631	

- (1) The effect of urbanization on hydrologic flows was taken into account.  
 (2) Average annual equivalent compound interest factor for 41 years of a 100-year economic life at 7 3/8 percent interest = 0.2874.  
 (3) Average annual equivalent straight line interest factor for 50 years of a 100-year economic life at 7 3/8 percent interest = 0.2823.

## FLOOD CONTROL BENEFITS

Benefits from flood damage reduction were evaluated as the difference in flood damages with and without the proposed project. Plates 5-3 and 5-4 show urbanized discharge-frequency damage relations for existing developments and for proposed project conditions. Flood damages under project conditions were subtracted from damages under preproject conditions to calculate benefits from flood damage reduction.

The increase in flood damages in the absence of a project results in an increase in benefits over those calculated for existing conditions. Rates of increase in benefits over the project life are the same as the weighted indexes calculated for projected flood damages as indicated in the tables on pages 5-29 and 5-30. These indexes are based on the growth rate of the content value applied to residential damages and population growth rates applied to public damages.

For the recommended 100-year designs, average annual flood control benefits over the life of the project are \$2,178,700 for State Road Coulee and \$788,800 for Ebner Coulee as shown in the following table.



Present and future average annual flood control benefits

Coulee	Existing conditions benefits 1980	Future benefits					Increase 1985-2085		Average annual equivalent of increase over 100-year project life (1)	Total average annual benefits
		1985	1995	2005	2015	2021	2035	2085		
State Road	\$1,733,000	\$1,826,600	\$2,055,300	\$2,353,400	\$2,740,800	\$3,050,600	\$3,051,800	\$3,051,800	\$1,225,200	\$2,178,700
Index	1.00	1.054	1.186	1.358	1.582	1.760	1.761	1.761		
Ebner	650,000	679,300	752,700	843,100	963,300	1,060,200	1,060,200	1,060,200	380,900	788,800
Index	1.00	1.045	1.158	1.297	1.482	1.631	1.631	1.631		

(1) Average annual equivalent compound interest factor for 41 years of a 100-year project life at 7 3/8 percent interest = 0.2874.

## RESIDUAL DAMAGES

Residual damages are the damages that would remain with the project in place. The State Road Coulee project would provide protection from the 100-year flood with 2 feet of freeboard. Average annual damages remaining would be \$4,700.

The Ebner Coulee area would experience greater residual damages with a project in place because of the flood susceptibility of an area of uncontrolled drainage. Even with a combined State Road and Ebner Coulee project, 60 acres would be inundated by the 100-year flood. Residual average annual damages with the Ebner Coulee plan would be \$182,000. The residual floodplain remaining after construction of the State Road Coulee project is shown on plate 5-5.

With the State Road Coulee project in place and no project on Ebner Coulee, residual damages would be limited essentially to those in the Ebner Coulee area. The total benefits with the State Road project in place are \$975,500. Residual damages are summarized in the following table.

Present and future residual average annual damages with project											
Item	Existing conditions 1980	Future damages					Increase 1985-2085	Average annual equivalent of increase over 100-year project life (1)	Total average annual residual damages		
		1985	1995	2005	2015	2021				2035	2085
State Road Coulee project	\$3,700	\$3,900	\$4,500	\$5,000	\$5,900	\$6,500	\$6,500	\$6,500	\$2,600	\$800	\$4,700
Ebner Coulee project	150,100	156,800	173,600	194,800	222,800	244,500	244,600	244,600	87,800	25,200	182,000
Residual damages with State Road Coulee project and without Ebner Coulee project (2)	803,800	840,000	930,800	1,042,900	1,192,000	1,311,200	1,311,300	1,311,300	471,300	135,500	975,500

(1) Average annual equivalent compound interest factor for 41 years of a 100-year life at 7 3/8-percent interest = 0.2874.

(2) This figure is the total of the Ebner Coulee flood damages and the residual damages for State Road Coulee (see table on page 5-31).

## RELATED BENEFITS

### LOCATION

The location benefit is the value of making floodplain land available for new uses by reducing flood hazards to activities which would use the floodplain only with protection. The plan permits residential and commercial use of the floodplain, which would be used for agricultural purposes or remain vacant without the plan. Analysis of changes in the market value of land is the method suggested by "Planning, NED Benefit-Cost Analysis," 15 July 1980.

Theoretically, market land value represents the present capitalized value of the future income stream associated with the expected uses of the land. The benefit is the difference in the market value of floodplain land with and without a plan. Large tracts of vacant land in the floodplain would be worth about \$70,000 per acre when platted if they could be developed into residential areas. If this land has to remain vacant, it would be worth about \$20,000 per acre if sold for other uses such as parks, golf courses, etc.

Ebner Coulee does not receive location benefits since its vacant lands are projected to be totally developed in the future. Ebner Coulee's vacant lands, and the remaining vacant acreages in State Road Coulee that are projected to be developed, will be included under the flood proofing cost savings benefit section. Average annual location benefits for State Road Coulee are \$18,600. The formulation of these benefits is shown in the following table.

Changes in the market value of land, State Road Coulee	
Item	Number
Number of vacant acres	8
Market value of vacant floodplain land	\$20,000
Market value of vacant floodplain land with project	70,000
Net increase per acre	50,000
Total benefits	400,000
Estimated maximum expected growth period	15 years
Shape of growth curve	Straight line
Present worth factor	0.637
1985 predevelopment benefits	\$254,800
Benefits generalized at a 7 3/8-percent rate of return	19,300
Estimated induced residual damages	700
Net benefits	18,600

#### SAVINGS IN ADMINISTRATIVE COSTS OF FLOOD INSURANCE

Regulation 713.523b in the Urban Flood Damage Section in "Planning, NED Benefit-Cost Analysis," 15 July 1980, requires that the costs of administering the flood control program be taken into account when determining damages.

The State Road and Ebner Coulee areas are eligible for flood insurance. However, channel improvements would reduce the limits of 100-year flooding so that flood insurance would be unnecessary in most parts of the watershed. The saving in the cost of administering the program would be considered a benefit creditable to the flood control project. It is assumed that the total annual reduction in flood insurance costs would equal the average annual residential and commercial flood control benefits from the project. These benefits, which total \$2,169,000 for State Road and \$787,400 for Ebner Coulee are the flood insurance cost savings.

These flood insurance cost savings, however, are transfer payments and thus are not considered as project benefits. Benefits that can be attributed to the project are derived from the saving of administration costs of unsubsidized premiums that are paid to private insurance companies. Unsubsidized premiums represent about 10 percent of the total premiums with the Federal Government paying the balance. Private insurance companies administer the program for a fee of 15 percent of the premiums. Thus annual benefits claimed for saving the administration costs of the flood insurance are approximately \$33,000 at State Road and \$12,000 at Ebner Coulee. This is equivalent to \$52 per home on State Road Coulee and \$25 per home on Ebner Coulee. These relationships are shown in the following table.

Savings of administrative costs of flood insurance						
Coulee	Total flood insurance cost savings	X	Unsubsidized premiums	X	Administration fee	Total
					=	Total
State Road	\$2,169,000	x	10 percent	x	15 percent	= \$33,000
Ebner	788,000	x	10 percent	x	15 percent	= 12,000
						\$52
						25

#### FLOOD PROOFING COST SAVING

Land use regulations pursuant to the Federal Flood Disaster Protection Act of 1973 are near certification. With adoption of these regulations, it is assumed that flood proofing costs will be incurred if a structure is located in the floodplain. The without project conditions assume that future buildings in the floodplain would be flood proofed by raising the ground elevation 1 foot above the elevation of the 100-year flood.

The with project conditions assume no flood proofing. Thus flood proofing savings would be a benefit of the project. The cost saving for the fill that would be made unnecessary by the project would amount to an annual benefit of \$9,200 for State Road Coulee and \$5,500 for Ebner Coulee. The vacant land which would be developed with or without the project is shown on plate 5-2. A summary of these benefits is shown in the following table.

Computation for flood proofing cost savings benefits

<u>Item</u>	<u>Amount</u>
<u>State Road (13 acres projected to be developed)</u>	
Fill required (2.3 feet x 13 acres x \$5,300 per acre-foot)	\$158,500
Cost saving benefits at present worth (\$158,500 x 0.785 <sup>(1)</sup> )	124,400
Annualized benefits at 7 3/8 percent interest (\$124,400 x 0.07381 <sup>(2)</sup> )	9,200
<u>Ebner Coulee (6 acres projected to be developed)</u>	
Fill required (3 feet x 6 acres x \$5,300 per acre-foot)	95,400
Cost saving benefits at present worth (\$95,400 x 0.785 <sup>(1)</sup> )	74,900
Annualized benefits at 7 3/8 percent interest (\$74,900 x 0.07381 <sup>(2)</sup> )	5,500

(1) 15 years of accelerated growth at 7 3/8-percent interest = 0.785.

(2) Interest and amortization at 7 3/8 percent for a 100-year project = 0.07381

INTENSIFICATION

The intensification benefit is the value of a plan to use floodplain lands for greater economic return. Development in the State Road and Ebner Coulees areas is recent and appears to be in very good physical condition. Existing structures should not require replacement before the year 2030. Therefore, no intensification benefits are claimed for State Road and Ebner Coulees.

LOCAL EMPLOYMENT

The benefits from employing local resources in building and maintaining the flood control project were deleted from this analysis. La Crosse has had an unemployment rate below the national average for the past 5 years. Early this year, the unemployment rate at La Crosse was about 5 percent.

Appendix 5

#### ADVANCE BRIDGE REPLACEMENT

Several existing bridges on State Road and Ebner Coulees would require replacement within the next 30 years. The proposed channel improvements and required bridgeworks would obviate the need for bridge replacements at a later date without the project. Thus, in accordance with EM 1120-2-104, the the proposed project can be credited with a benefit for this advance replacement. Advance bridge replacement benefits for State Road and Ebner Coulees are \$32,700 and \$26,200, respectively, as summarized in the following table.



Advance bridge replacement benefits						
Bridge	First cost (1)	Year of expected replacement	Interest and amortization factor for		Interest and amortization factor for	
			100 years at 7 3/8 percent	Present worth of one per period 95 years hence	100 years at 7 3/8 percent	Present worth of one per period 15 years hence
<u>State Road Coulee</u>						
Hagen Road	\$111,100	1985	0.07381		0.07381	\$8,200
Drive-In	144,700	2000	0.07381	13.995		3,900
Broadview Plaza	82,600	1985	0.07381			6,100
Railroad	196,500	1985	0.07381			14,500
Total						32,700
<u>Ebner Coulee</u>						
Entrance Road	19,000	1985	0.07381			1,400
29th Street	54,200	1985	0.07381			4,000
Park Drive	51,500	1985	0.07381			3,800
Railroad bridge	314,000	1990	0.07381	14.015	0.07381	17,000
Total				0.709		26,200

(1) First cost is indexed up by a factor of 1.48 (ENR Const Jan 75 to Oct 80).  
(2) This column annualizes the cumulative effect of the "present worth of one per period" column.

## SUMMARY

The totals of the average annual benefit categories for the State Road and Ebner Coulees projects are shown in the following table.

Benefits	Total average annual benefits	
	State Road Coulee	Ebner Coulee
Flood control	\$2,178,700	\$788,800
Location	18,600	0
Savings of flood insurance costs	33,000	12,000
Flood proofing cost savings	9,200	5,500
Advance bridge replacement	<u>32,700</u>	<u>26,200</u>
Total	2,272,200	832,500

The benefit-cost ratios at 7 3/8-percent interest, including future growth flood control benefits and other related benefits, are shown below.

Item	Benefit-cost ratio including future growth		
	100-year design		
	State Road Coulee	Ebner Coulee	Combined
Average annual benefit	\$2,272,200	\$832,500	\$3,104,700
Average annual charges	1,469,000	867,000	2,336,000
Net benefits	803,200	-34,500	768,700
Benefit-cost ratio	1.55	0.95	1.33

## SENSITIVITY ANALYSIS

### EFFECT OF USING OBERS SERIES E PROJECTIONS ON PROJECT FEASIBILITY

OBERS Series E projections were tested in the future growth flood control benefit evaluation instead of Series C to determine the effects on the recommended plans. Using Series E, per capita income is projected to increase from \$3,800 in 1980 to \$15,100 in 2035, an increase of 3.97. Series C projects an increase of 4.23 during the same time period, as shown on page 5-25.

These results indicate that flood control benefits for State Road and Ebner Coulees were reduced by 1 percent. The benefit-cost ratios at 7 3/8 percent including all types of benefits and using Series E projections were 1.56 for State Road and 0.95 for Ebner Coulee. Series E projections had no significant effect on benefit-cost ratios for the two projects.

#### EXISTING CONDITIONS BENEFIT-COST RATIO

The benefit-cost ratios for 1980 existing conditions flood control benefits at 7 3/8 percent interest are shown in the following table.

<u>Benefit-cost ratios for 1980 existing conditions (flood control)</u>		
<u>Item</u>	<u>State Road Coulee</u>	<u>Ebner Coulee</u>
Average annual benefits	\$1,733,000	\$650,000
Average annual charges	1,469,000	867,000
Net benefits	264,000	-217,000
Benefit-cost ratio	1.18	0.75

#### INTERNAL RATE OF RETURN

The internal rate of return is the interest rate at which benefits would equal costs over the 100-year period of analysis. This rate is about 12 percent for State Road Coulee and about 7 1/8 percent for Ebner Coulee.



- 100 YR FLOODPLAIN
- 500 YR FLOODPLAIN
- - - - - STANDARD PROJECT
- ..... ZONE SEPARATION LINE

N

AD-A120 480

FLOOD CONTROL STATE ROAD AND EBNÉR COULEES LA CROSSE  
WISCONSIN GENERAL DE..(U) CORPS OF ENGINEERS ST PAUL MN  
ST PAUL DISTRICT APR 82

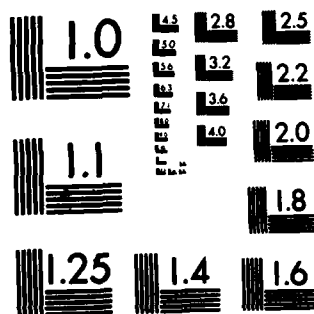
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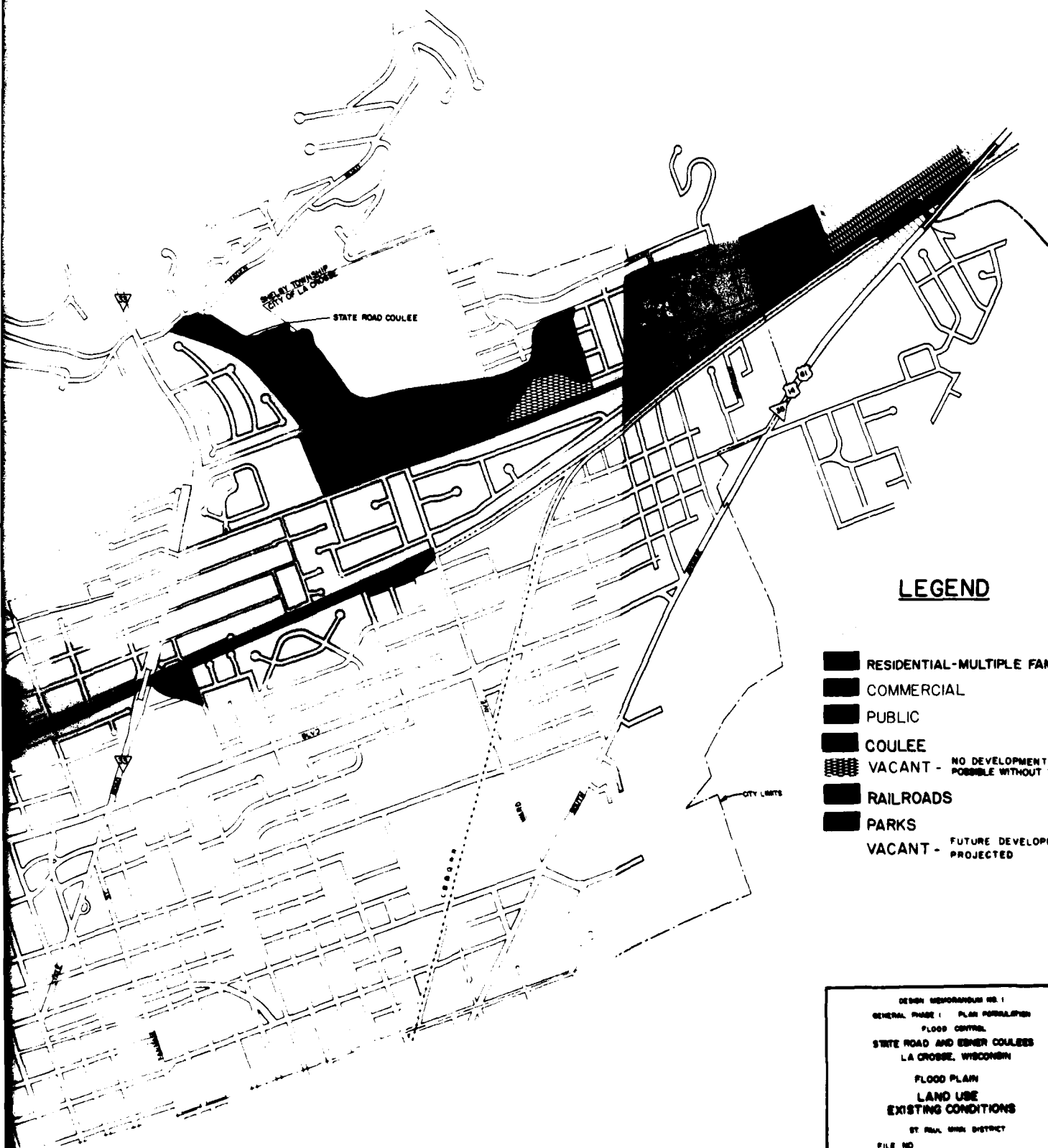


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A





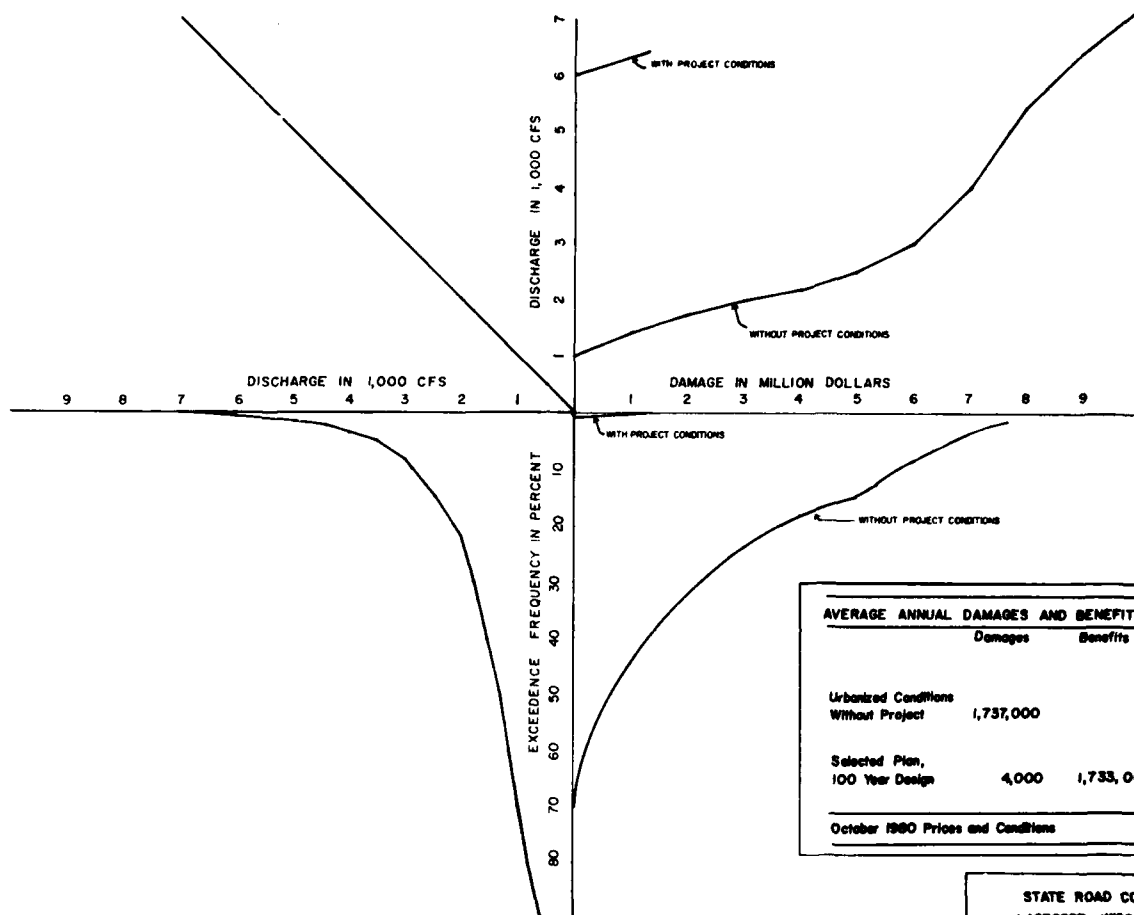




## LEGEND

- RESIDENTIAL-MULTIPLE FAMILY
- COMMERCIAL
- PUBLIC
- COULEE
- VACANT - NO DEVELOPMENT POSSIBLE WITHOUT PROJECT
- RAILROADS
- PARKS
- VACANT - FUTURE DEVELOPMENT PROJECTED

DESIGN MEMORANDUM NO. 1  
 GENERAL PHASE I PLAN PRELIMINARY  
 FLOOD CONTROL  
 STATE ROAD AND EBER COULEES  
 LA CROSSE, WISCONSIN  
 FLOOD PLAIN  
 LAND USE  
 EXISTING CONDITIONS  
 ST. PAUL MISS. DISTRICT  
 FILE NO.

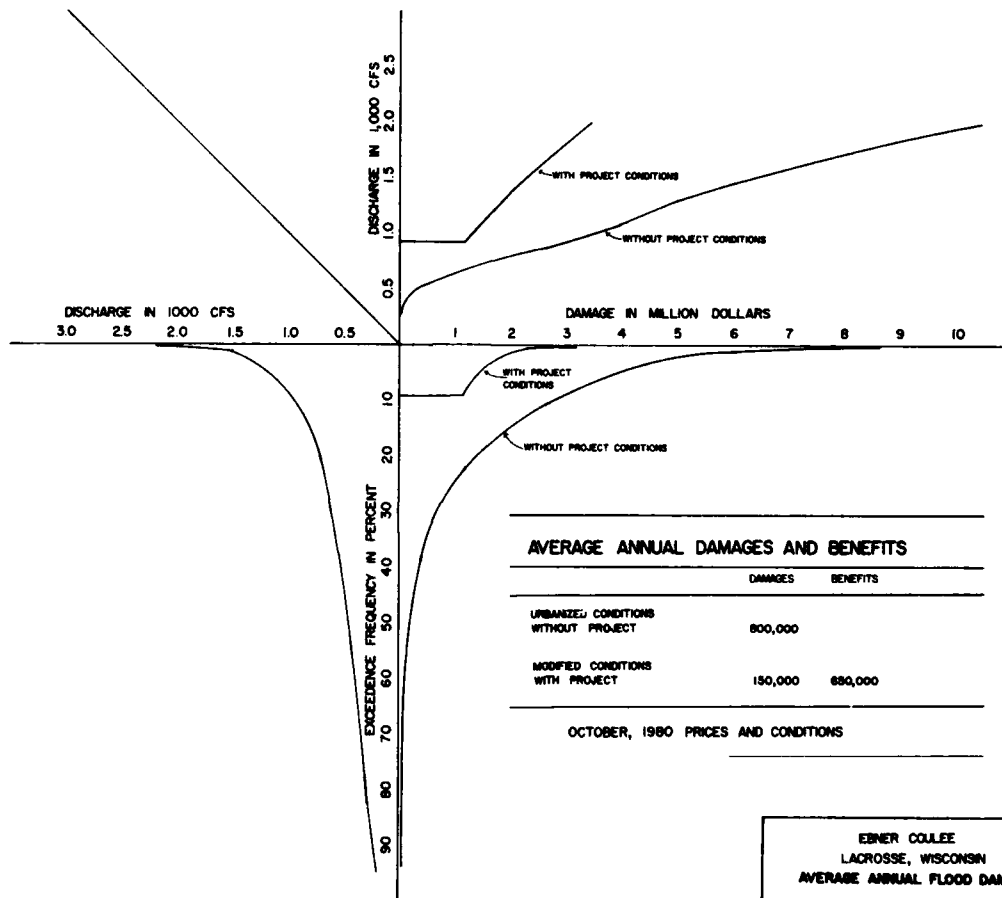


AVERAGE ANNUAL DAMAGES AND BENEFITS		
	Damages	Benefits
Urbanized Conditions		
Without Project	1,737,000	
Selected Plan, 100 Year Design	4,000	1,733,000
October 1980 Prices and Conditions		

STATE ROAD COULEE  
LACROSSE, WISCONSIN

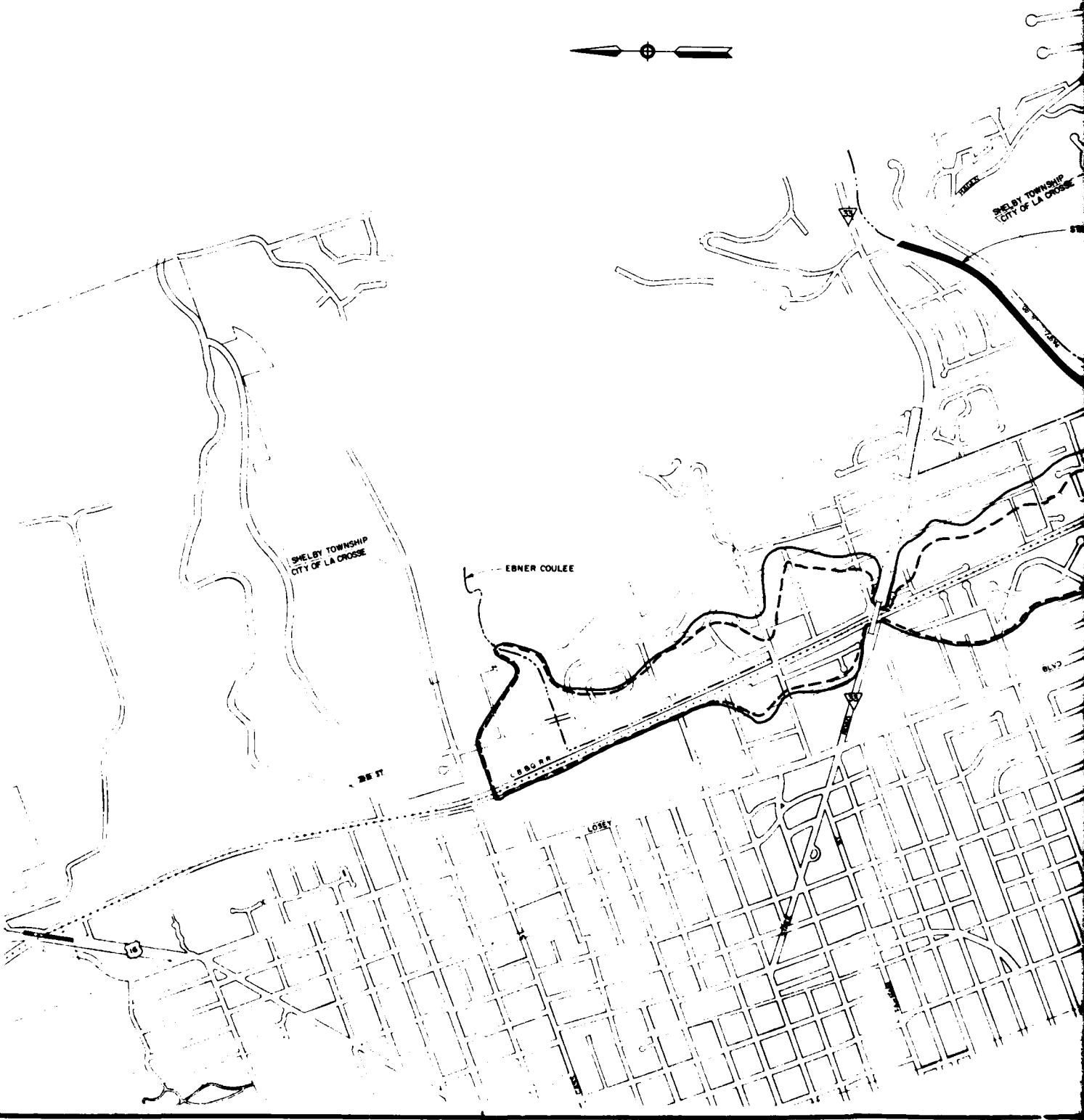
Average Annual Flood Damage  
Relationships

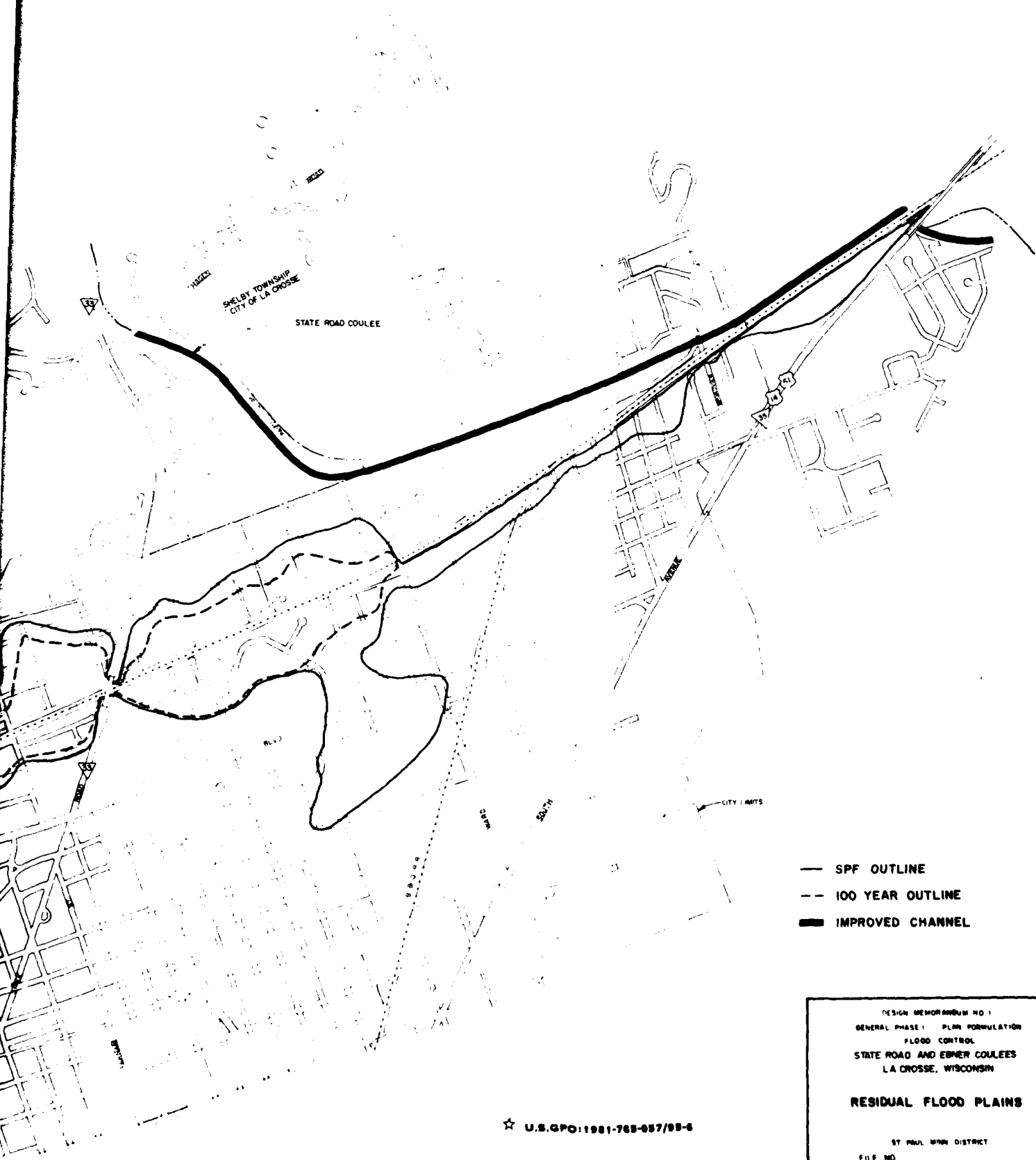
St. Paul, Minnesota District



EBNIER COULEE  
LACROSSE, WISCONSIN  
AVERAGE ANNUAL FLOOD DAMAGE  
RELATIONSHIPS  
ST PAUL, MN DISTRICT

PLATE 5-4





- SPF OUTLINE
- - 100 YEAR OUTLINE
- IMPROVED CHANNEL

DESIGN MEMORANDUM NO. 1  
GENERAL PHASE 1 PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND EBNER COULEES  
LA CROSSE, WISCONSIN

**RESIDUAL FLOOD PLAINS**

ST. PAUL WYOM. DISTRICT  
FILE NO.

☆ U.S.G.P.O. 1981-763-057/95-6

RELATED STUDIES

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PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

RELATED STUDIES

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RESUME	6-3
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1979-1980 STATE ROAD-EBNER COULEE FLOOD INSURANCE STUDY	6-4
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PLATE

NUMBER

6-1      GENERAL LOCATION

## APPENDIX 6

### RELATED STUDIES

#### INTRODUCTION

Considerable time and effort were invested in arriving at the 100-year and standard project flood (present conditions) outlines used in this report. Additional effort was involved in earlier studies in connection with area flood control planning and the Federal Flood Insurance program. A list of pertinent studies and maps and a description of their relevance to the current phase I GDM flood outlines are included in the following material. A general location map showing the State Road-Ebner Coulee drainage basin and flood prone areas is shown on plate 6-1.

#### LISTING OF STUDIES

A chronological list of floodplain maps and studies that were prepared for the State Road-Ebner Coulee areas is given below.

- Survey Report for State Road and Ebner Coulees, 1967. Report contains an investigation of flood control alternatives. It does not include the existing condition 100-year or standard project flood profiles.
- Corps of Engineers Flood Plain Information report by Stanley Consultants, Muscatine, Iowa, April 1970. This report contains 100-year and standard project flood outlines for State Road and Ebner Coulees.
- Federal Insurance Administration Flood Hazard Boundary Maps, 18 April 1975. These maps show 100-year flood outlines for State Road and Ebner Coulees. (Ref.: Gannett Fleming Cordry & Carpenter, Inc., Harrisburg, Pennsylvania, 19 June 1975 letter (flood outline is from the 1970 Flood Plain Information Report map).)



- Flood Insurance Study for La Crosse County done by Owen Ayres and Associates under contract to the Federal Insurance administration, 1975. The study provides 100- and 500-year flood zone information for the unincorporated areas surrounding the city of La Crosse. (See detailed narrative following this summary.) The hydrology for this study is identical to that of the November 1976 Phase I GDM study for State Road and Ebner Coulees.

- Flood Insurance Study for the city of La Crosse, 1976. This study was started but not completed by the firm Dames and Moore of Washington, D.C. The study was completed in detail for all of La Crosse except State Road and Ebner Coulees. This study provided 100- and 500-year flooded outlines within the city, including the State Road and Ebner Coulee area, but assigned no flood insurance zones. The 1976 La Crosse study and the 1975 La Crosse County study agree with each other.

- Revised Flood Insurance Rate Maps prepared by the Federal Insurance Administration, 14 May 1976. These maps show the approximate 100- and 500-year flood outlines and zones for State Road and Ebner Coulees.

- Corps of Engineers General Design Memorandum, Phase I, November 1976. This report provides the design plan formulation and the hydrology needed for flood control on the two coulees. The 100-year flood outline is shown on plate 5-1 of the report. The standard project flood is discussed but not shown in the report.

- Updated Flood Insurance Rate Maps prepared from undated maps by Dewberry, Nealon, & Davis (now employed by Dames & Moore, Washington, D.C.), 14 May 1977.

- Flood Insurance Study (1979-1980) completed by the Corps of Engineers with HEC-1 and 2, 1980. The study established 10-, 50-, 100-, 500-year flood outlines and flood zone numbers with an accompanying text. Essentially this study completed the unfinished 1976 Dames & Moore report for the incorporated area of the city of La Crosse. This study also provides the basis for the 100-year and standard project flood outlines contained in this revised phase I GDM report for State Road and Ebner Coulees.

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● Ongoing flood insurance study, 1980. This study covers the area upstream of Hagen Road Bridge for approximately 1 1/2 miles along State Road Coulee. It expands on the 1979-1980 downstream area study by the Corps of Engineers. The study is being conducted under a joint agreement among La Crosse County, the Wisconsin Department of Natural Resources, and the U.S. Soil Conservation Service. The study will develop 10-, 50-, 100-, and 500-year flood profiles and 100- and 500-year floodplain maps.

#### RESUME OF PRINCIPAL STUDIES

##### 1975 LA CROSSE COUNTY FLOOD INSURANCE STUDY<sup>(1)</sup>

The purpose of the study was to investigate the existence and severity of flood hazards in La Crosse County and to aid in the administration of the Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. (p. 1)

State Road and Ebner Coulees were studied in detail the entire length of the streams, except for a short reach on State Road Coulee, in the right overbank of the stream from Hagen Road to the Burlington Northern railroad tracks. (p. 4)

Flood profiles and floodplains with recurrence intervals of 10, 50, 100, and 500 years were developed for State Road and Ebner Coulees. (p. 6)

Unit hydrographs were synthesized from hydrologic data supplied by the Corps of Engineers for State Road and Ebner Coulees. The unit hydrographs were then used to compute frequency-discharge relationships. Only Clark's Synthetic Unit Hydrograph method was used for State Road Coulee, but various methods were used for Ebner Coulee. (p. 7)

For each stream studied in detail, the boundaries of the 100- and 500-year floods were delineated using the flood elevations determined at each cross section. In cases where the 100-year and 500-year flood boundaries are close together, only the 100-year boundary was shown. The 100-year flood is the Federal Insurance Administration's adopted base flood for purposes of floodplain management. (p. 12)

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(1) Numbered references are to 1975 report.

## 1979-1980 STATE ROAD-EBNER COULEE FLOOD INSURANCE STUDY

This flood insurance study investigated the existence and severity of flood hazards in the city of La Crosse in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The study included State Road and Ebner Coulees.

The 1979-1980 study will be used by the Office of Insurance and Hazard Mitigation (OIHM) to convert the city of La Crosse to the regular program of flood insurance. Planners will use this study in their efforts to promote sound floodplain management.

Flood profiles and flooded area outlines for the 10-, 50-, 100-, and 500-year floods were developed for State Road and Ebner Coulees. (The standard project flood was also developed specifically for use in connection with this phase I GDM report.) The 100-year, 500-year, and standard project flood outlines developed for this study are shown on plate 5-1 in the Economic Base, Flood Damage and Benefit Analysis Appendix.

A Flood Insurance Rate Map was the principal product of the 1979-1980 flood insurance study. This map is published separately from the study and contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water surface elevations of the base (100-year) flood. The city of La Crosse has adopted a new floodplain ordinance with the Flood Insurance Rate Map, both of which were approved by the Wisconsin Department of Natural Resources on 13 November 1980.

### SUMMARY

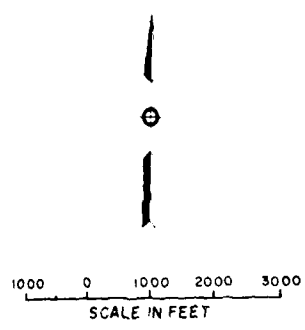
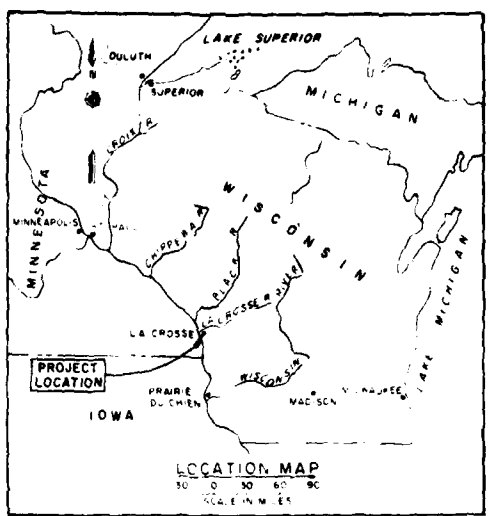
The 1975 La Crosse County study flood profiles and flood outlines were revised by the subsequent 1979-1980 study work. This later study of State Road and Ebner Coulees was made at the request of the Wisconsin Department of Natural Resources. The 1980 effort improved on the accuracy of the 1975 study.

A comparison of the 1975 and 1980 study results showed relatively minor differences. However, the 1980 study results provide the final basis for flood insurance mapping and insurance rates for State Road and Ebner Coulees. The 1980 study also provides the basis for the current phase I GDM flood damage analysis.

Appendix 6

MISSISSIPPI RIVER





- LEGEND
- WATERSHED BOUNDARY
  - 100 YEAR FLOOD OUTLINE
  - WATERCOURSE
  - STORM SEWER

8 APRIL 1977-Photography by Mark Murd



DESIGNED BY	DATE	APPROVED
DEPARTMENT OF THE ARMY ST PAUL DISTRICT CORPS OF ENGINEERS ST PAUL, MINNESOTA		
DESIGN MEMORANDUM NO 1 FLOOD CONTROL		
STATE ROAD AND EBNER COULEES LA CROSSE, WISCONSIN		
GENERAL LOCATION		
SUBMITTED BY	DATE	
APPROVED	DATE	
DRAWING NUMBER		
SHEET OF		

EBNER COULEE PLAN (INFEASIBLE - NOT RECOMMENDED)

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PREPARED BY THE  
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DEPARTMENT OF THE ARMY

**EBNER COULEE PLAN (INFEASIBLE - NOT RECOMMENDED)**

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EBNER COULEE PLAN (INFEASIBLE - NOT RECOMMENDED)

INTRODUCTION

The Ebner Coulee portion of the authorized project was found not economically feasible for 100-year protection and is not recommended for construction. However, a detailed 100-year plan cost estimate and optimization for Ebner Coulee are presented in appendix 7 because of the extensive amount of time and effort that have gone into this project. The most feasible 100-year flood protection plan for Ebner Coulee is shown on plate 11 of the main report.

CHANNEL MODIFICATION AND DIVERSION

The most economical 100-year protection plan would divert flows northward to Miller Coulee and thence to the La Crosse River floodplain. Flows would leave the Ebner Coulee bluff area and enter a 16-foot wide, concrete-lined, rectangular flume through a box inlet drop structure. The flume would follow an alignment adjacent to and north of the existing alignment to the Burlington Northern railroad tracks. A stilling basin would be provided just downstream of the 29th Street bridge to reduce high velocities caused by steep slopes in the upper reach. A conceptual view of the proposed flume is shown on plate 7-1.

Two 154- by 97-inch reinforced concrete arch pipes would convey flows from downstream of the stilling basin to the confluence with Miller Coulee. A drop structure at this point would convey the combined flow from Ebner and Miller Coulees under the Burlington Northern railroad bridge into an enlarged Miller Coulee channel to U.S. Highway 16. Downstream of U.S. Highway 16, flows would be conveyed by a rectangular concrete-lined channel to the marsh adjacent to the La Crosse River.

The capacity of the channel would range from 1,490 cfs at the upstream terminus to 3,410 cfs at the outlet. The existing channel adjacent and parallel to the railroad tracks from the bend in the channel at station 68+00 southward to the Farnam Street storm sewer inlet would be preserved.



This channel would convey any local runoff originating below the design project to the Farnam Street storm sewer inlet. The required acquisition width, including 25 feet of right-of-way for construction and maintenance, would vary from 41 feet to 115 feet from the upstream to the downstream end of the proposed Ebner Coulee channel.

The only developed area along the diversion route is between Cass and Main Streets where backyards of homes abut the railroad right-of-way. One house and one garage would have to be relocated or removed to provide sufficient right-of-way for placement of the two underground conduits.

#### BRIDGE RELOCATIONS

The proposed channel improvements for Ebner Coulee would involve replacement or modification of several bridges. Most of the existing street and railroad crossings over the Ebner Coulee diversion route are in poor structural condition, are obsolete by today's highway standards and urban needs, and have inadequate waterway openings for safe passage of design flood flows. The bridge modifications would provide safe and efficient crossing for residents and easy access to areas of present and potential urban development.

The proposed diversion works on Ebner Coulee would require new single and multiple cell concrete box type structures at Entrance Road (station 84+46), 29th Street (station 72+15), Park Drive (station 5+00), and U.S. Highway 16. The existing single cell box culvert at U.S. Highway 16 would be a part of the proposed improvement. All other existing bridges would be removed. The proposed diversion works would also require a new railroad bridge and a junction structure at station 16+65 to combine the flows from Ebner and Miller Coulees. Plates 7-1 and 7-2 show the diversion works and new bridges required for an Ebner Coulee project.

## UTILITY CHANGES

Both public and private utilities at numerous locations would require modifications to accommodate the proposed improvements. These modifications include changes in alignment and grade for utilities running parallel and crossing the proposed channel. Coordination of utility relocation work by the various owners would be extensive. The sequence of relocation work would require considerable planning to minimize service disruptions in the area.

The following table shows the approximate locations of all required utility changes.

Utility changes required with the Ebner Coulee plan		
Utility	Size or description	Approximate location
<u>Public</u>		
Water main	6-inch diameter	Park Drive
	20-inch diameter	State Street
	6-inch diameter	Main Street
	8-inch diameter	Cass Street
Sanitary sewer	8-inch diameter (force main)	Park Drive
	Siphon	Main Street
Storm sewer	36-inch diameter	U.S. Highway 16
	12-inch diameter	Burlington Northern railroad
	18-inch diameter	Main Street
	24-inch diameter	King Street
<u>Private</u>		
Power lines	Primary circuit	Main Street to North End
	Primary circuit	Main Street
	Primary circuit	Cass Street
Gas mains	2-inch	U.S. Highway 16
	4-inch	Main Street
	2-inch	Cass Street
Telephone	Aerial cable	Park Lane
	Aerial cable	Main Street
	Aerial cable	Cass Street
CATV	Local	Burlington Northern railroad
	Local	Main Street

The city of La Crosse owns all public utilities affecting Ebner Coulee. Power lines and gas mains are owned by Northern States Power Company. The La Crosse Telephone Company owns the communication lines, while the cable television lines are the responsibility of Teleprompter of La Crosse.

## ENVIRONMENTAL CONSIDERATIONS

The proposed Ebner Coulee plan would have minor direct or indirect effects on the environment. On the Ebner Coulee diversion, from the railroad crossing upstream through the golf course and residential area, underground conduits would be used to minimize loss of backyards and golf course land. Even so, disruptions would occur during construction. A chain link fence would be provided to prevent people, especially small children, from entering the concrete channel. Although the fence would not be an absolute barrier, it would prevent people from inadvertently or unknowingly entering the channel. Additional safety features such as hand-holds or steps in the channel sides would be desirable and would be incorporated in later investigations.

Additional right-of-way required for the Ebner Coulee diversion is 13.6 acres. Of this, 8.0 acres is residential or commercial land and 5.6 acres is public land.

## OPERATION AND MAINTENANCE

No elements of the project would require operation. However, the improved channels, the drop structures, the stilling basins, and the junction structure would need to be maintained to ensure the continued effectiveness of the project. Maintenance would be the responsibility of local interests.

## COST ESTIMATES

The following table shows an itemized breakdown of estimated project first costs based on October 1980 prices.

Detailed estimate of first costs, Ebner Coulee

<u>Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit cost</u>	<u>Total estimated cost</u>
<u>Federal first costs</u>				
<u>Bridge relocations</u>				
Burlington Northern bridge at station 16+65	Sum	Job	-	\$396,600
<u>Utility relocations</u>				
Sanitary	Sum	Job	-	19,500
Water	Sum	Job	-	41,400
Gas	Sum	Job	-	3,300
Storm sewer	Sum	Job	-	29,000
Total utility relocations				93,200
<u>Channels</u>				
Excavation (marsh)	CY	5,296	\$2.20	11,700
Excavation (common)	CY	200,300	2.20	440,700
Riprap	CY	4,200	30.00	126,000
Filter material	CY	2,100	11.00	23,100
Concrete, (including cement)	CY	4,682	259.00	1,212,600
Reinforcing steel	Lb	468,200	0.50	234,100
Inlet structure at station 86+30	Sum	Job	-	1,052,300
Drop structure at station 16+65	Sum	Job	-	50,500
Trash rack at station 16+65	Sum	Job	-	29,600
Arch pipe 154 x 96 inches	LF	9,690	389.00	3,769,400
Sand drains	CY	2,800	9.00	25,200
Compacted sandfill	CY	3,889	3.50	13,600
Stilling basin approxi- mate station 71+45	Sum	Job	-	98,000
Chain link fence	LF	4,922	9.00	44,300
Landscaping	Sq mi	0.93	14,800.00	13,800
Sodding	SY	7,744	1.50	11,600
Contingencies				<u>1,251,500</u>
Total channels				8,408,000
Total direct construction cost				8,897,800

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Detailed estimate of first costs, Ebner Coulee (cont)				
Item	Unit	Quantity	Unit cost	Total estimated cost
<u>Indirect cost</u>				
Total engineering and design				\$845,300
Supervision and administration				<u>667,300</u>
Total indirect cost				1,512,600
Total Federal first cost				10,410,400
<u>Non-Federal first cost</u>				
<u>Lands and damages</u>				
Fee title, public lands	Sum	Job	-	179,900
Fee title, residential	Sum	Job	-	234,000
Fee title, commercial	Sum	Job	-	86,800
Contingencies				100,200
Acquisition costs	Sum	Job	-	<u>69,200</u>
Total lands and damages				670,100
<u>Relocations</u>				
<u>Bridge relocations</u>				
Park Street (station 65+00)	Sum	Job	-	90,600
Entrance road (station 84+46)	Sum	Job	-	35,100
29th Street (station 72+15)	Sum	Job	-	90,700
Highway 16 (station 7+02)	Sum	Job	-	180,900
Ramps to bridges	Sum	Job	-	44,000
Contingencies				<u>88,700</u>
Total bridge relocations				530,000
<u>Miscellaneous relocations</u>				
Power lines				8,400
TV cable				700
Telephone				10,700
Road modification, Main Street and Cass Street crossing				22,400
Contingencies				<u>8,100</u>
Total miscellaneous relocations				50,300
Total relocation indirect costs (engineering, design, supervision, and administration)				85,500
Total relocation costs				<u>665,800</u>
Total non-Federal first cost				1,335,900
Total cost, Ebner Coulee				11,746,300

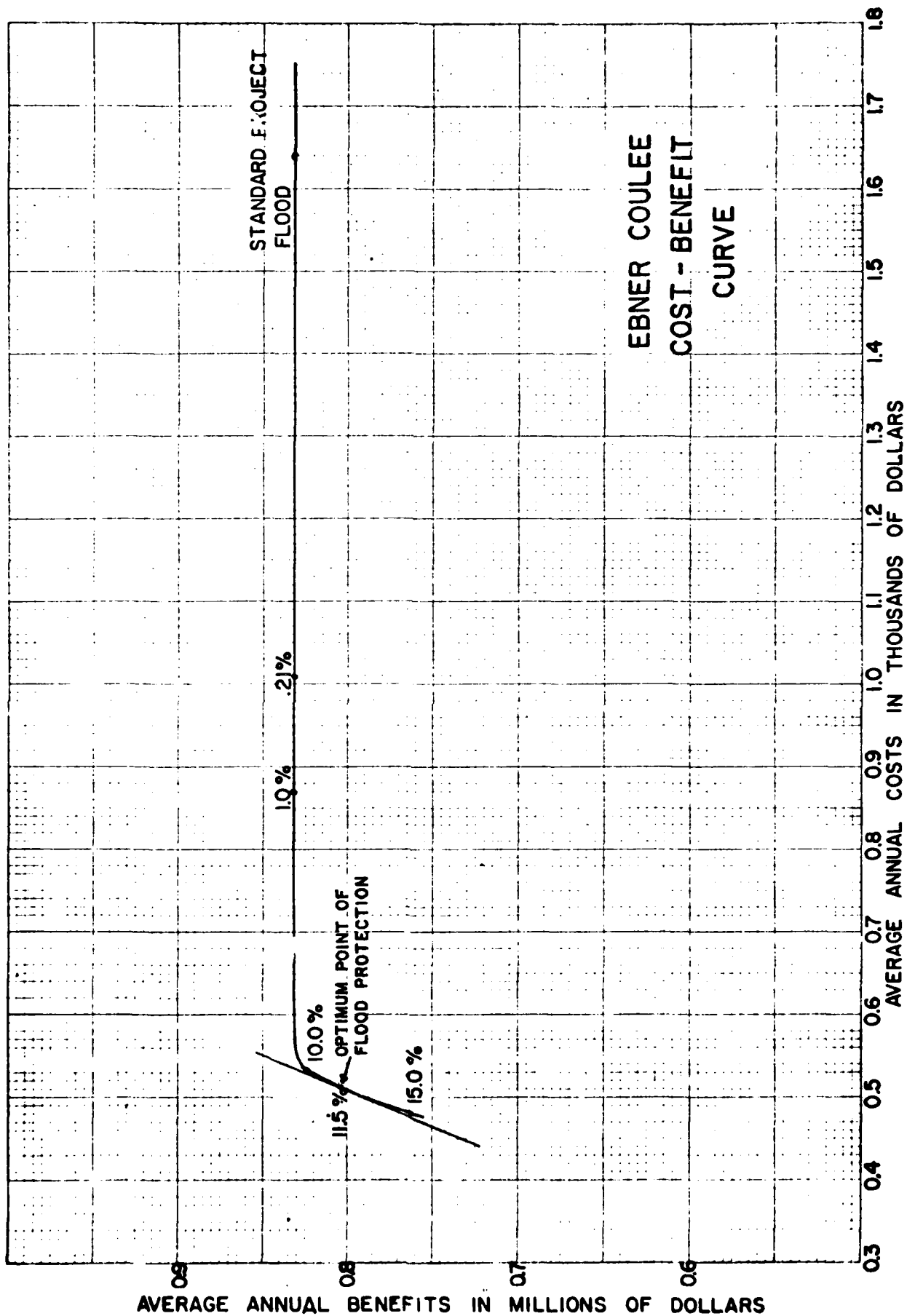
(1) The unit cost for concrete also includes allowances for the control of minor stormwater runoff and backfill for rectangular concrete channel sections.

## WITH STATE ROAD PROJECT

The effects of constructing the State Road Coulee project without constructing the Ebner Coulee project are illustrated on plate 7-4. Lower flood elevations occur in the Ebner Coulee left overbank area between Ward Avenue and Green Bay Street with the State Road project in place. The lower levels will result because present State Road Coulee right overbank flows between Hagen Road and Ward Avenue will cease with the project.

## OPTIMIZATION

The optimum level of flood protection for Ebner Coulee was also evaluated by determining the economic, environmental, and social aspects of four different channel modification design capacities. The annual costs and benefits were based on a 100-year economic life and an interest rate of 7 3/8 percent. The channel design capacities would provide protection from floods with estimated 15.4-, 9.1-, 1-, and 0.21-percent frequencies of occurrence. The following figure graphically shows the economic optimum level of flood protection which occurs with a project designed to provide protection from a flood having an 11.5-percent chance of occurrence. The table on pages 7-10 through 7-12 provides economic, environmental, social, and regional impact data for the economic optimum design condition and four other levels of flood protection including protection from the standard project flood. The environmental impacts for various degrees of flood protection are essentially the same, except for the size of the remaining floodplain area.





Comparative design levels - channel modification and diversion (plan 12) - economic, environmental and social impacts

	15.0-			10.0-			1.0-			0.21-			Standard
	percent	design	frequency	percent	design	frequency	percent	design	frequency	percent	design	frequency	

Ebner Coulee  
I. NATIONAL ECONOMIC DEVELOPMENT (1)  
(A through F in \$1,000)

A. Total first cost	6,512	7,208	11,746	14,603	22,185
1. Federal first cost	5,688	6,290	10,410	12,842	19,432
2. Non-Federal first cost	824	918	1,336	1,761	2,753
B. Total annual OM&R cost	2	2	2	2	2
1. Federal	0	0	0	0	0
2. Non-Federal	2	2	2	2	2
C. Total average annual cost	481	532	869	1,078	1,637
1. Federal	420	464	759	948	1,434
2. Non-Federal	61	68	110	130	203
D. Total average annual benefits	763	823	832	832	832
1. Flood damage reduction	737	797	806	806	806
2. Transportation	26	26	26	26	26
E. Net average annual benefits	282	291	-37	-37	-37
F. Remaining average annual flood damages	69,000	9	0	0	0
G. Benefit-cost ratio (interest rate = 7 3/8 percent)	1.59	1.55	0.96	0.77	0.51

II. ENVIRONMENTAL QUALITY

A. Woodland gained or lost (± acres)	-0.8	-0.8	-1.5	-2.3	-3.2
1. Urban area	0	0	0	0	0
2. Uplands	-0.3	-0.3	-0.3	-0.3	-0.4
3. Bottomlands					
B. Herbaceous areas (± acres)	-4.0	-4.0	-5.0	-6.0	-9.0
1. Parks and public lands	-2.5	-3.5	-4.0	-5.0	-6.0
2. Lawns	-0.1	-0.1	-0.5	-1.2	-2.2
3. Other	-0.3	-0.3	-0.4	-0.6	-1.0
C. Wetlands gained or lost (± acres)					
D. Streams affected					
1. Intermittent flow drainage course					
a. Existing natural drainage course					
b. Existing channelized					
(1) Channel affected (miles)	0.7	0.7	0.7	0.7	0.7
(2) Percent of total length affected	100	100	100	100	100
2. Effect on stream erosion and sedimentation					
3. Effect on stream water quality					
4. Effect on stream water temperature					

None affected

Major decrease

None

None

Comparative design levels - channel modification and diversion (plan 12) - economic, environmental and social impacts

	15.0-	10.0-	1.0-	0.21-	Standard
	percent	percent	percent	percent	percent
	design	design	design	design	design
	frequency	frequency	frequency	frequency	frequency

Ebner Coulee

II. ENVIRONMENTAL QUALITY (Cont)

E. Effect on water table				Minor (lower)	
F. Effect on scenic, recreation, or wilderness areas				Minor decrease	
G. Riparian corridors lost or gained				None	
H. Wildlife management area and refuges lost or gained				None in area	
I. Effect on air quality				None	
J. Rare, endangered, or threatened animal species affected				None known in area	
K. Rare or unique vegetation systems affected				None known in area	
L. Historical and/or archeological sites affected				None presently known	
M. Effect on cultural centers				No centers in affected area	

III. SOCIAL WELL-BEING

A. Area remaining in floodplain (acres) (2)	93	85	60	60	60
B. Flood protection					
1. Residences protected (3)	340	366	370	370	370
2. Businesses protected (including farmsteads)	1	1	1	1	1
3. Persons protected	1,190	1,280	1,300	1,980	1,980
4. Total flood damage reduction (percent)	59	64	100	100	100
C. Relocations required					
1. Residences	1	1	1	1	10
2. Businesses (including farmsteads)	0	0	0	0	0
3. Persons	4	4	4	4	38
4. Highways and streets (miles)	0.2	0.2	0.2	0.2	0.3
5. Utilities (miles)					
a. Sewers (storm and sanitary)	0.1	0.1	0.1	0.1	0.2
b. Water lines	0.1	0.1	0.1	0.1	0.2
c. Communication lines	0.2	0.2	0.2	0.2	0.3
d. Sewer lines	0.2	0.2	0.2	0.2	0.3

Comparative design levels - channel modification and diversion (plan 12) - economic, environmental and social impacts

	15.0-			10.0-			1.0-			0.21-		
	percent	design	frequency	percent	design	frequency	percent	design	frequency	percent	design	frequency
Ebner Coulee												
III. SOCIAL WELL-BEING (cont)												
D. Lands required (acres) (4)												
1. Public	8			12			14			16		21
2. Private	3			5			6			7		9
a. Residential	5			7			8			9		12
b. Business including crop	3			5			5			6		8
3. Park and open space	2			2			3			3		4
4. Other	0			0			0			0		0
E. Bridge modifications or removal	0			0			0			0		0
F. Roads severed	4			4			4			4		4
G. Socially important sites affected							None					
H. Effect on community patterns							None known					
I. Effect on public health hazards associated with flooding							Minor					
J. Effect on public safety hazards associated with flooding							Moderate improvement			Major improvement		Major improvement
K. Effect on recreation opportunities												
1. Hunting							None					
2. Fishing							None					
3. Hiking and biking							Potential increase					
4. Picnicking and camping							None					
IV. REGIONAL ECONOMIC DEVELOPMENT												
A. Effect on tax base										Slight loss		
B. Effect on recreation expenditures										Potential increase		
C. Effect on regional economic growth												
1. During construction										Increase		
2. During project life										Increase		

- (1) Average annual costs and benefits were computed using an interest rate of 7 3/8 percent.
- (2) The channel area required to convey the design flow is included. The floodplain is the area flooded by the 100-year flood for existing conditions.
- (3) The figures include direct structural damage reduction to 370 residences, and remaining residential units receive a reduction in damage to surrounding grounds and in access problems.
- (4) The figures shown are those lands required in addition to the area occupied by the existing channel and levees of approximately 5 acres.

## 100-YEAR PROTECTION

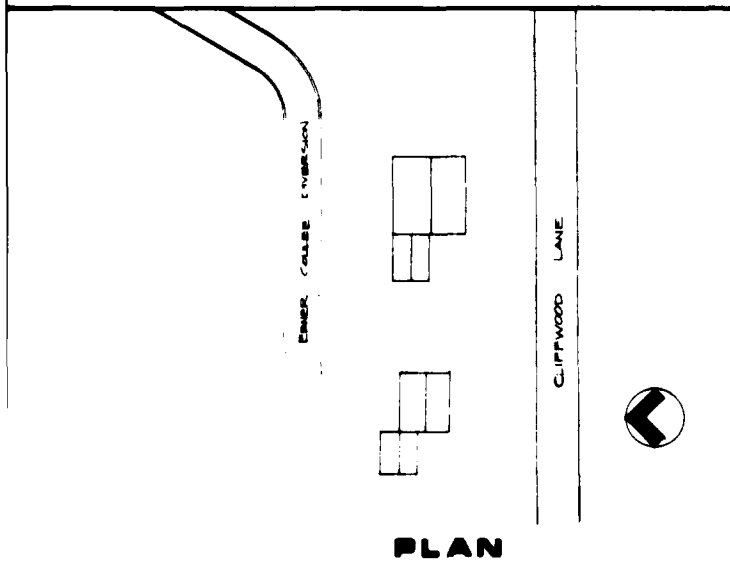
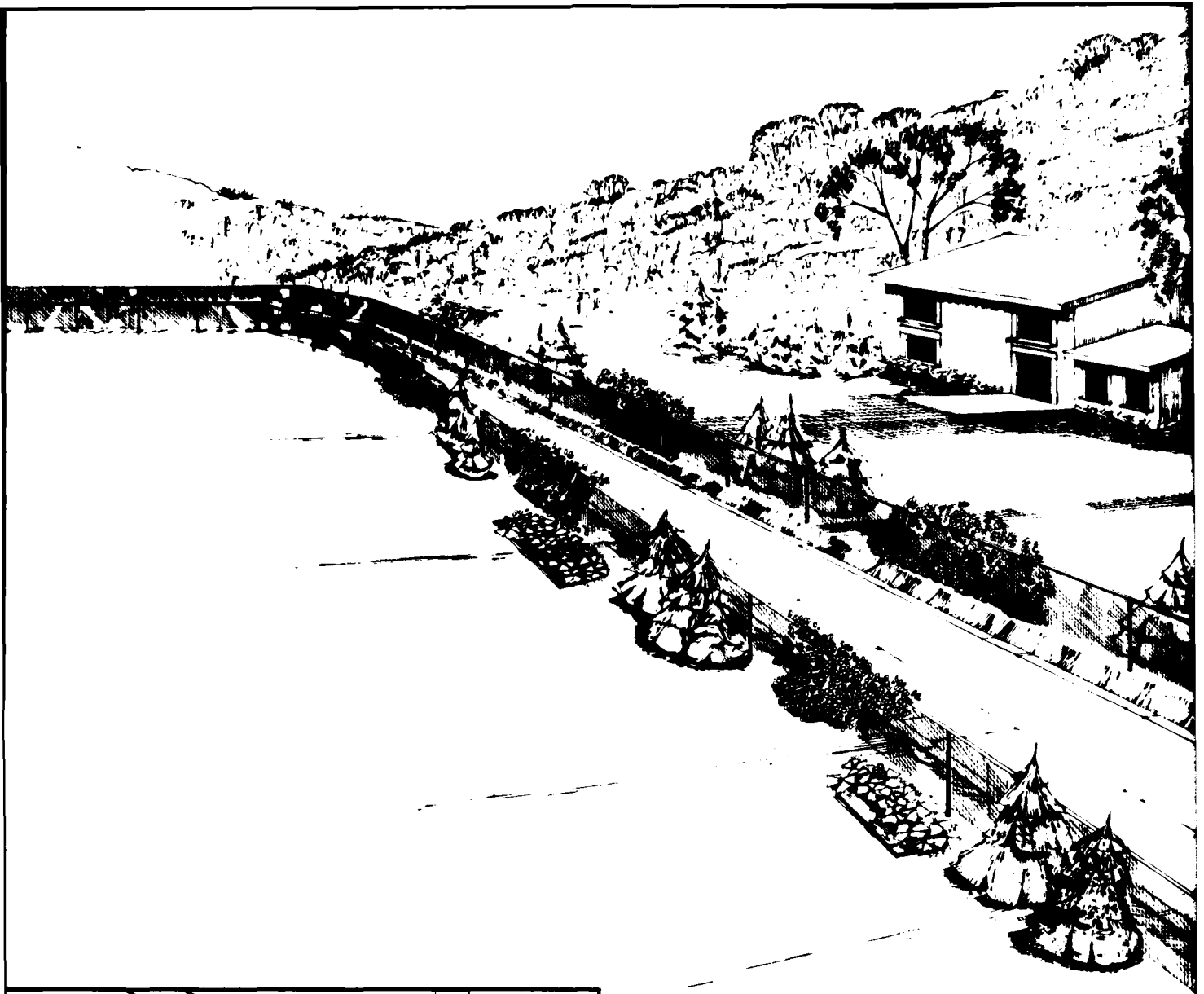
According to Corps of Engineers guidance, the minimum acceptable level of protection for projects designed for urban areas is 100 years (1-percent) exceedence. In the case of Ebner Coulee, the 100-year design is not economically feasible. Total average annual first costs for 100-year protection are \$869,000 versus \$832,000 in average annual benefits, as shown on page 7-10. The resulting benefit-cost ratio is 0.96.

## STANDARD PROJECT FLOOD

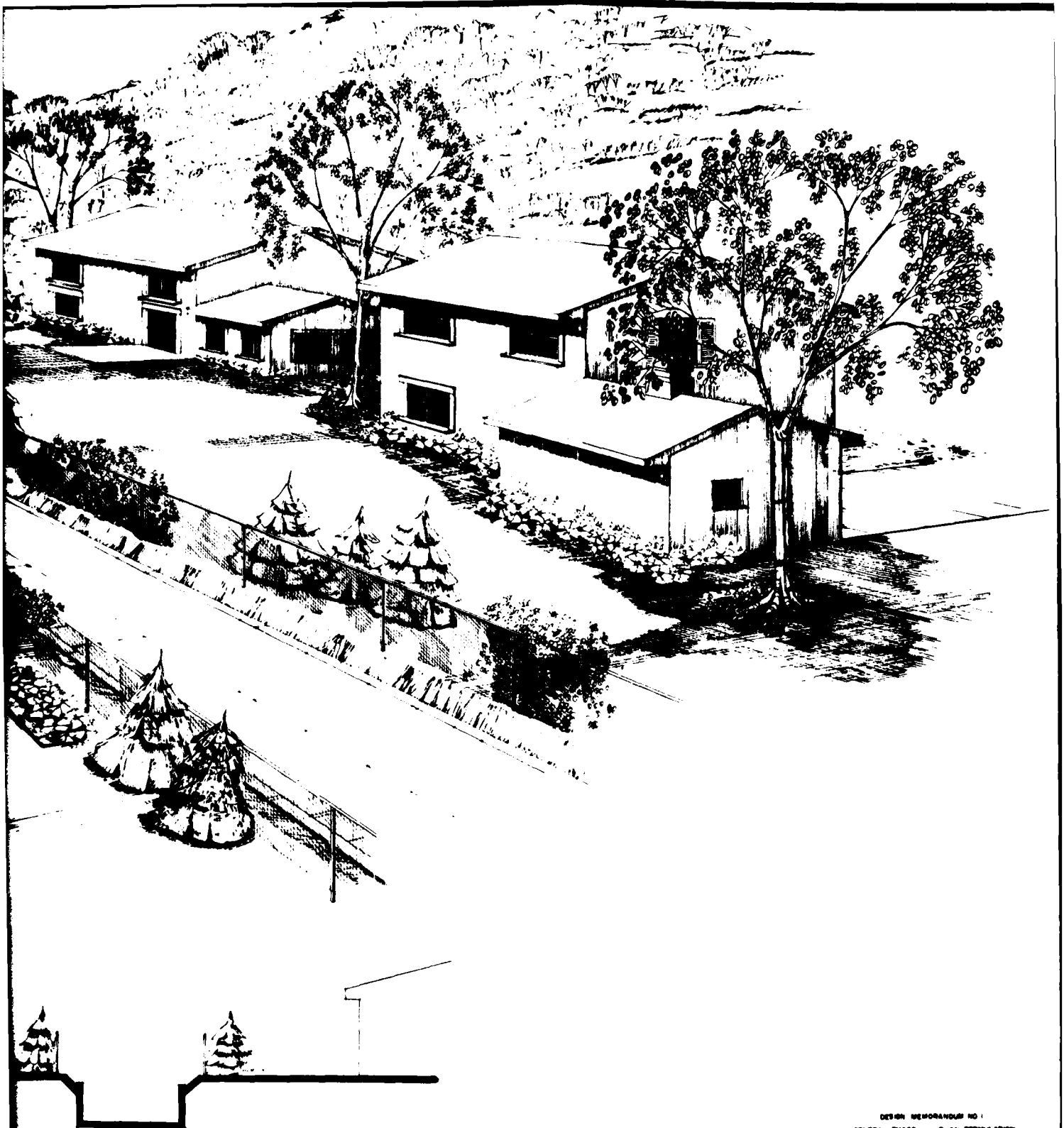
The table on pages 7-10 through 7-12 includes impact data for protection against the standard project flood. This level of protection is not economically justified (benefit-cost ratio is 0.51), and any plan providing protection from a flood greater than approximately the 11.5-percent chance flood is not economically justified. Therefore, the best overall plan is considered to be channel modification and diversion works sized to contain the 10-percent chance flood from Ebner Coulee plus floodplain regulation and flood insurance for the 60-acre area susceptible to flooding by the drainage area not controlled by the structural modifications. A single occurrence of the standard project flood with the above plan in place would cause estimated damages of \$5.0 million. For existing conditions the damages are estimated at \$10.5 million.

## AESTHETIC

The major aesthetic impacts of a proposed 100-year protection plan would occur directly in the project area. Improvements provided in the Ebner Coulee channels would include removal of unsightly channel growth, removal of earth levees, and landscaping of the right-of-way adjacent to the open channel portions. In addition, channel improvements would reduce turbidity and erosion. The channel would be lower than the adjacent ground level, thus, making its presence less conspicuous.



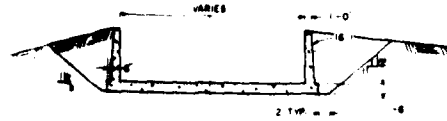
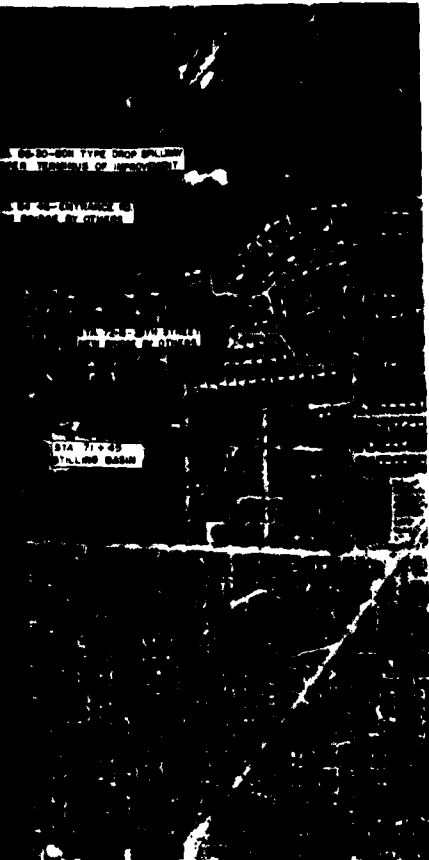
CROSS SECTION



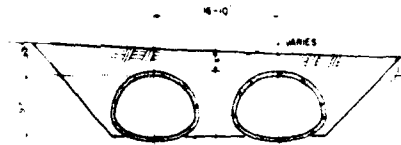
**CROSS SECTION**

DESIGN MEMORANDUM NO. 1  
 GENERAL PHASE I PLAN FORMULATION  
 FLOOD CONTROL  
 STATE ROAD AND EBNER COULEES  
 LA CROSSE, WISCONSIN  
 EBNER, COULEE  
 RECOMMENDED CHANNEL MODIFICATION  
 CONCEPTUAL VIEW NEAR  
 29th ST. BRIDGE  
 ST. PAUL WARD DISTRICT  
 FILE NO.

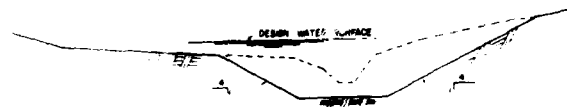




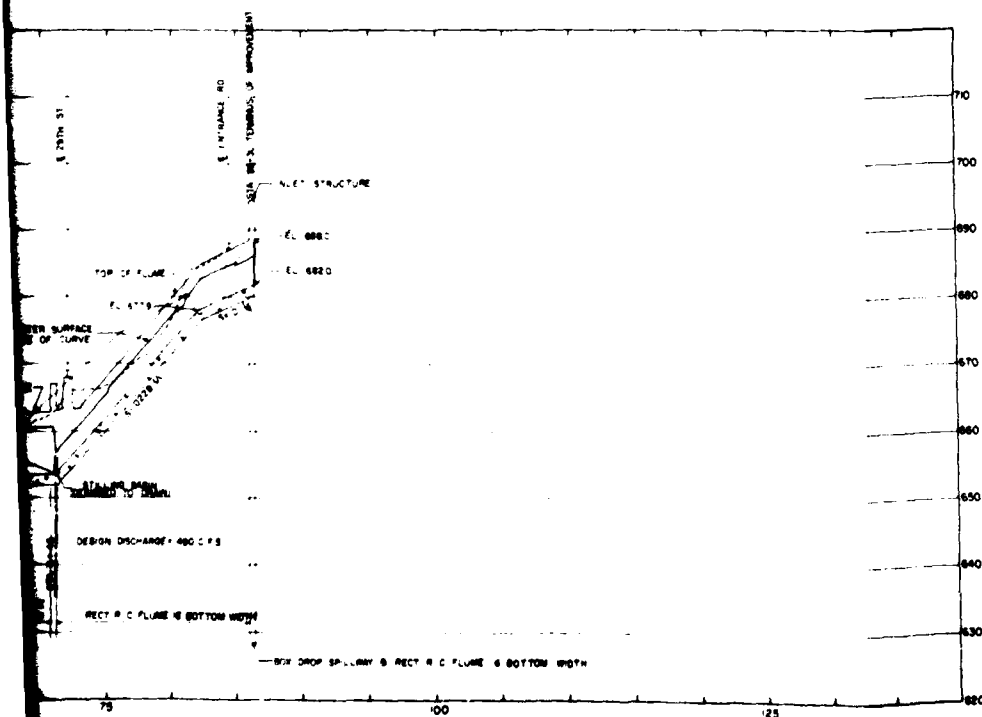
**R.C. RECTANGULAR FLUME**  
TYPICAL SECTION



**R.C. PIPE ARCH CONDUITS**



**EARTH CHANNEL**  
TYPICAL SECTION



**NOT RECOMMENDED FOR CONSTRUCTION**

EXPECTED BENEFITS ARE  
LESS THAN PROJECT COST

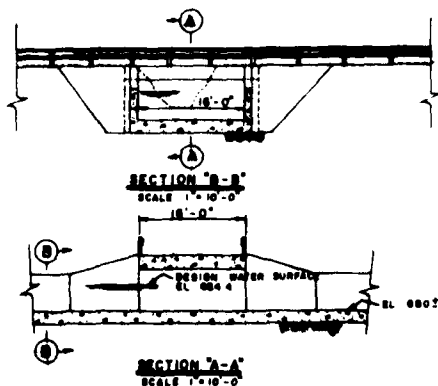
DESIGN MEMORANDUM NO. 1  
GENERAL PHASE 1 PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND EBMER COULEE  
LA CROSSE, WISCONSIN

EBMER COULEE  
PROPOSED DIVERSION WORK  
ALIGNMENT & PROFILE

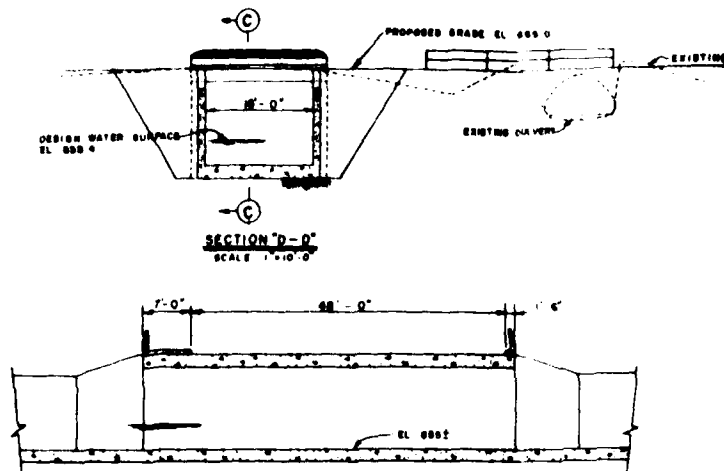
ST PAUL DISTRICT  
FILE NO



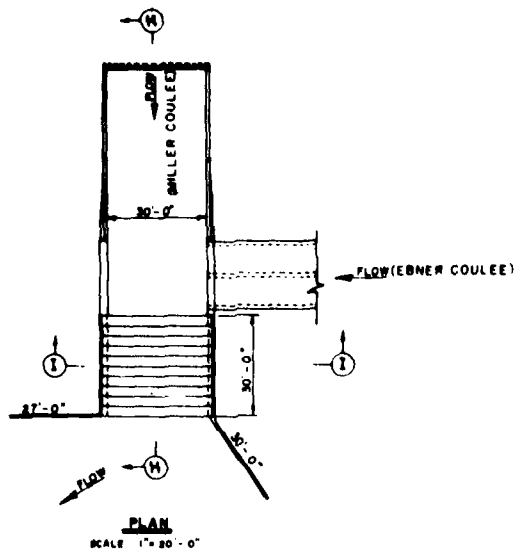
NOTE: EXISTING BRIDGE TO BE REMOVED  
 DESCRIPTION: SINGLE SPAN CONCRETE FLAT SLAB BRIDGE ON CONCRETE  
 ABUTMENTS TOTAL BRIDGE LENGTH 17'



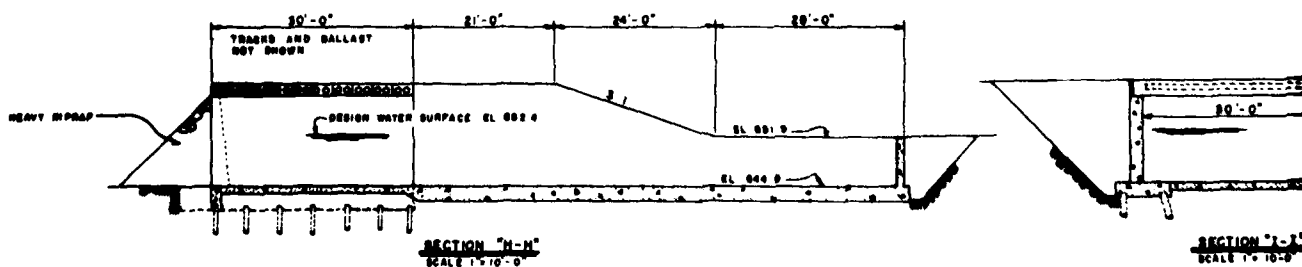
ENTRANCE ROAD BRIDGE AT STA. 84+46



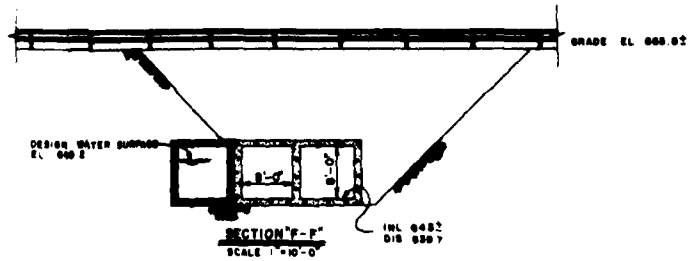
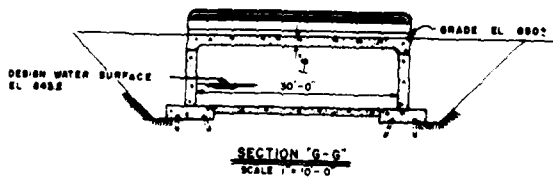
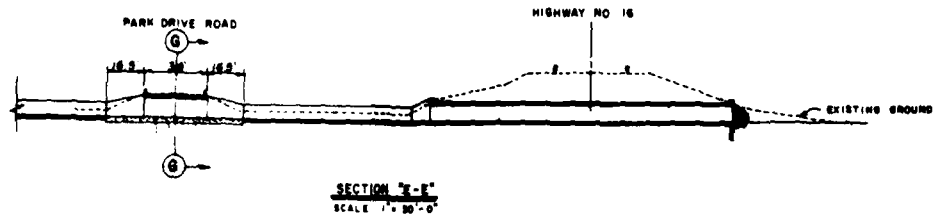
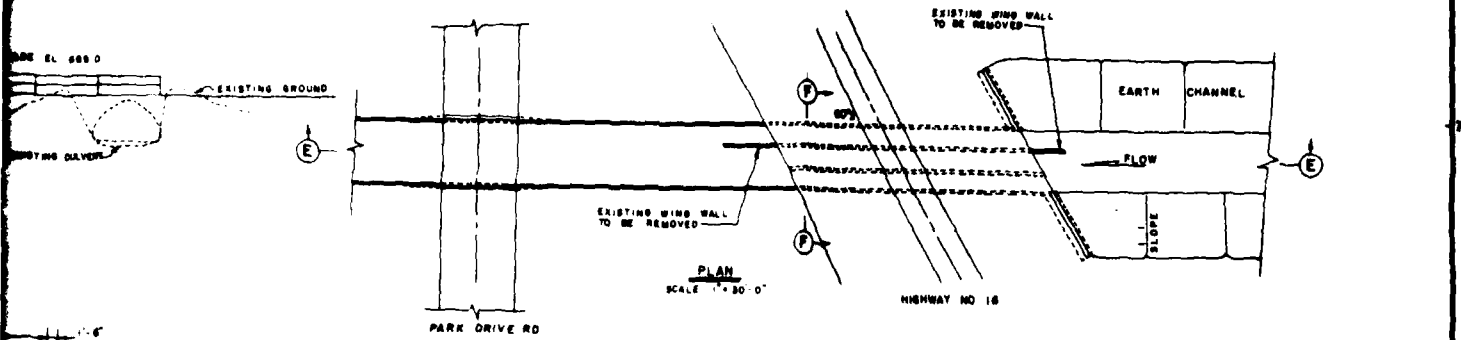
29TH ST BRIDGE AT STA. 72+15



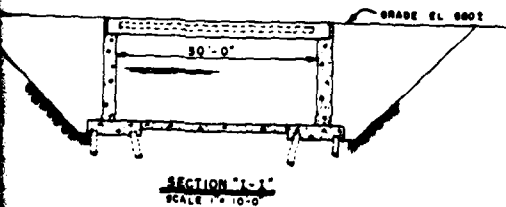
NOTE: EXISTING BRIDGE TO BE REMOVED  
 DESCRIPTION: 3 CONC PIPE ARCHES 72" X 70"



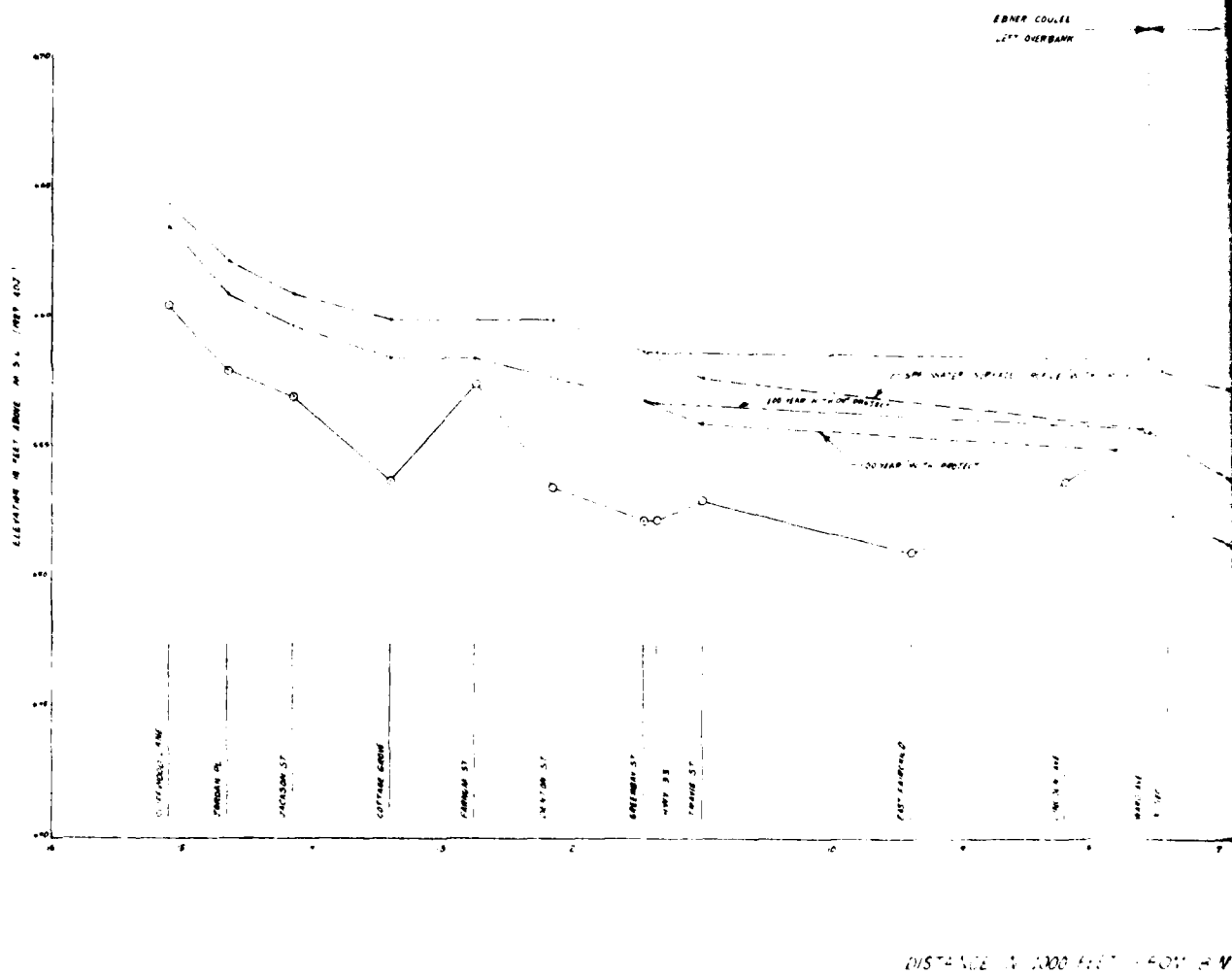
B.N. RAIL ROAD BRIDGE AT STA. 16+65



PARK DRIVE BRIDGE AT STA 5+00 AND DOUBLE BOX CULVERT HIGHWAY NO. 16 AT STA 6+41 TO STA 7+64.3



DESIGN INFORMATION NO. 1  
GENERAL PURPOSE: PLAN FOR BRIDGE  
FLOOD CONTROL  
STATE ROAD AND EMBANKMENT  
LA CROSSE, WISCONSIN  
EDNER COULEE  
BRIDGES  
ST. PAUL AND DISTRICT  
FILE NO.



DATE  
NAME

DESIGN NO.  
DRAWING NO.

STATE ROAD AND EBNER COULEE  
FLOOD CONTROL  
PROFILES  
WITH AND WITHOUT STATE ROAD PROJECT

MINNAPOLIS NORTH-WEST R.R. BRIDGE

LEGEND  
--- WITH PROJECT  
--- WITHOUT PROJECT

FEET

DESIGN MEMORANDUM NO.  
GENERAL PHASE PLAN FORMULATION  
FLOOD CONTROL  
STATE ROAD AND EBNER COULEE  
PROFILES  
WITH AND WITHOUT STATE ROAD PROJECT  
BY PAUL W. W. DISTRICT  
FILE NO.

☆ U.S.GPO:1961-768-087/77-8

2

PLATE 7-4

DATE  
FILMED  
8